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OF THE

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OF THE

STATE AGRICULTURAL EXPERIMENT STATION

AT

AMHERST, MASS.

1888.

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BARN AND FEEDING STALLS OF THE EXPERIMENT STATION.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

BOARD OF CONTROL, 1888.

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* Left July 1, 1888. † Left Nov. 1, 1888. ‡ Left April 1, 1888.

BOSTON, Jan. 9, 1889.

To the Honorable Senate and House of Representatives.

In accordance with chapter 212 of the Acts of 1882, I have the honor to present the Sixth Annual Report of the Board of Control of the State Agricultural Experiment Station.

WM. R. SESSIONS,

Secretary.

SIXTH ANNUAL REPORT

OF THE

DIRECTOR OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN: — The past year has been, for several reasons, an eventful one in the history of the Massachusetts State Agricultural Experiment Station. The State Legislature of 1888 has passed two acts affecting the organization and the work of the Station. The membership of the Board of Control has been increased, and the management of the new regulations for the trade in commercial fertilizers has been assigned to the director of the Station. The Board of Control has also assumed the responsibility of attending to all the chemical work called for in connection with investigations instituted in the various departments of the Hatch Experiment Station, reserved by the authorities of the Massachusetts Agricultural College. The terms agreed to by the Board of Trustees of the college and the Board of Control of the Massachusetts Experiment Station allow five thousand dollars of the Hatch fund for that work. The character of the additional work, as well as the increase in financial resources, has rendered some change in the working force of the Station advisable. To meet the growing demand for assistance in adopted lines of investigation, a department of vegetable physiology has been organized with a view to assist in particular in the investigation of diseases of plants by microscopic observations and otherwise. Prof. James Ellis Humphrey of North Weymouth, Mass., a graduate of Lawrence Scientific School, Harvard University,

late professor of botany at the University of Indiana, Bloomington, Ind., was elected to the professorship of vegetable physiology, and entered upon his duties Nov. 1, 1888. A desirable increase of assistance in the chemical department of the Station for the coming year will be provided by some members of the senior class of the Agricultural College, who are already in training at the Station.

The work carried on during the past year has been in the main in three directions, namely: to determine the cost of food for the production of milk and pork, field experiments with different kinds of farm crops, and chemical examinations of a variety of substances of interest to farmers. The results of the season are, on the whole, quite satisfactory. Unfavorable weather during a considerable part of summer and autumn interfered at times, somewhat, with a more general success in field experiments, yet not in a sufficient degree to question seriously the previous statement.

The chemical laboratory has received a valuable addition of necessary apparatus. The library of the Station has been enriched by the addition of books and journals needed for reference in the special lines of investigations instituted. The stalls for feeding experiments have been enlarged in the direction pointed out in the preceding annual report. Most of the farm buildings are, as far as circumstances permit, in a good state of preservation; some of them, however, need a new coat of paint.

The chemical examinations in the laboratory have been in various directions, and exceptionally numerous. Fodder articles, fertilizers, products as well as refuse materials of various industries, have been tested with reference to their agricultural value. Much work has been done to determine the sanitary conditions of water supply in small towns and on farms. The resources of the chemical department have been engaged to their full capacity to meet the growing call for assistance on the part of our farming community.

The work for the improvement of the farm lands has been continued. Drill culture has been largely adopted for the renovation of the lands, and green manuring has extensively served to develop and economize inherent sources of plant food. The area prepared for future field experiments has

been enlarged in various parts of the farm. From nine to ten acres of permanent grass land have been added to our fodder sources. Every field of the farm has been made to contribute, as far as practicable, to that end. A detailed description of the work carried on in the different parts of the farm will be found in the accompanying report.

The buildings for stock feeding have been considerably enlarged for the purpose of inaugurating experiments regarding the cost of feed for the production of mutton and beef. The general arrangement for serving the feed has been improved with a view to enter, whenever advisable, upon experiments to study the rate of digestibility of fodder plants peculiar to American farm industry. The live stock of the Station consists at present of two horses, six cows, two steers, six sheep and nine pigs. All, with the exception of the horses, serve at present in experiments to ascertain the cost of feed for the production of milk or meat.

The details of the work carried on in the barn, the field and the laboratory, during the past year, are recorded in the subsequent pages, under the following headings: —

Feeding Experiments.

I. Experiments with milch cows; English hay, corn stover, fodder corn, ensilage, corn and cob meal, wheat bran and gluten meal.

II. Experiments with milch cows; green fodder, vetch and oats, Southern cow-pea, corn meal, wheat bran and gluten meal.

III. Experiments with pigs; skim milk, corn meal, corn and cob meal, gluten meal and wheat bran.

IV. On fodder supply and analyses of fodder articles.

Field Experiments.

V. Fodder corn raised with single articles of plant food.

VI. Fodder crops raised with and without complete manure.

VII. Experiments with vetch and oats, serradella and Southern cow-pea.

VIII. Experiments with potatoes, roots and miscellaneous crops.

IX. "Potato Scab," by Prof. James Ellis Humphrey.

Work in the Chemical Department.

X. Fertilizer laws and fertilizer analyses; miscellaneous analyses.

XI. Water analyses.

XII. Compilation of analyses of fodder articles, with reference to food value.

XIII. Compilation of analyses of fodder articles, with reference to fertilizing ingredients.

XIV. Compilation of analyses of agricultural chemicals and refuse materials used for fertilizing purposes.

.XV. Meteorological observations.

The periodical publications of the Station have been continued at such intervals as circumstances advise. The public interest in the bulletins and annual reports is steadily increasing. The State authorities have authorized the publication of twenty-five thousand copies of the annual report; and the call for our bulletins has necessitated the printing of nine thousand copies, with a prospect of the need of ten thousand in the near future. The obligation imposed upon the director of the Station by the new laws for the regulation of the trade in commercial fertilizers, to issue, during a large part of the year, a monthly statement of analyses of fertilizers made under his direction, will materially increase the periodical publication. It appears advisable in the interest of economy to publish the analyses of fertilizers as far as practicable in the form of business circulars, and to reserve the discussion of experimental work to the periodical bulletins.

All parties engaged with me in the work of the Station have faithfully attended to the tasks assigned to them; and it is with particular pleasure that I publicly recognize that fact.

I cannot consider my whole duty on this occasion fulfilled without expressing my sincere thanks to you for your kind support during the past year.

Yours very respectfully,

C. A. GOESSMANN,

Director of the Massachusetts Agricultural Experiment Station.

AMHERST, MASS., Jan. 9, 1889.

ON FEEDING EXPERIMENTS.

1888.

I. Feeding Experiments with Milch Cows; English Hay, Corn Stover, Fodder Corn, Corn Ensilage, Corn Meal, Corn and Cob Meal, Wheat Bran and Gluten Meal.

II. Feeding Experiments with Milch Cows; Green Fodder, Vetch and Oats, Southern Cow-pea, Hay, Rowen, Corn Meal, Wheat Bran and Gluten Meal.

III. Feeding Experiments with Pigs; Skim Milk, Corn Meal, Corn and Cob Meal, Gluten Meal and Wheat Bran.

I. Feeding Experiments with Milch Cows; English Hay, Corn Stover, Fodder Corn, Corn Ensilage, Corn Meal, Corn and Cob Meal, Wheat Bran and Gluten Meal.

During the year 1886 a series of feeding experiments with milch cows was inaugurated for the purpose of comparing the feeding effects of dry corn fodder, of corn ensilage and of corn stover, as a substitute in whole or in part for English hay; and that of corn ensilage, as compared with various kinds of roots, as far as practicable, under corresponding circumstances. The same variety of corn, if not otherwise specified, served for each trial. The corn ensilage used on these occasions has been produced in every instance from a corn crop of the same advanced state of maturity as the one which furnished the dry corn fodder, *i. e.*, at the beginning of the glazing over of the kernels.

The daily diet of the cows consisted, at the beginning of the experiment, of three and one-quarter pounds of corn meal, an equal amount of wheat bran, and all the hay they could eat. This combination of fodder articles was adopted as the basis of our investigation mainly for the reason that

it had been used in some of our earlier feeding experiments, and not on the assumption of its being the best possible combination of fodder articles for milch cows. The actual amount of hay consumed in each case was ascertained by weighing out a liberal supply of it and deducting subsequently the hay left over. The statement made in our records in this connection refers to the average consumption of hay per day during the feeding period.

The temporary changes in the diet, whenever decided upon, were carried out gradually, as it is customary in all carefully conducted feeding experiments. At least five days are allowed in every instance to pass by, in case of a change in the character of the feed, before the daily observations of the results appear in our published records. The dates which accompany all detailed reports of our feeding experiments, past and present, furnish exact figures in that direction This is in particular the case whenever such statements are of a special interest for an intelligent appreciation of the final conclusions presented. The weights of the animals were taken on the same day of each week, before milking and feeding.

The valuation of the various fodder articles consumed was based on the average local market price per ton in Amherst, 1886–1887 : —

Good English hay, .	$15 00	Rye middlings, . .	$24 00
Corn meal, . . .	23 00	Dry corn fodder (stover),	5 00
Wheat bran, . . .	20 00	Corn ensilage, . . .	2 75
Gluten meal, . . .	23 00	Carrots, ...	7 00

To assist those not yet familiar with the various points which ought to be taken into consideration when deciding the relative agricultural value of fodder articles at our disposal, the following short discourse on this subject, from the preceding annual report, is here reprinted. The value of a fodder for dairy purposes may be stated from two distinctly different stand-points : namely, with reference to its influence on the temporary yield of milk and the general condition of the animals which consume it, and in regard to its cost, *i.e.*, its physiological and commercial value. The relative commercial value of a fodder article again depends on its

first cost in the market, and on the value of the fertilizing constituents left in the manurial matter after it has served for food. The market value and actual feeding effect of one and the same article do not necessarily correspond with each other; in fact, they rarely coincide. The market value may be stated for each locality by one definite number. The feeding effect of one and the same substance, simple or compound, varies under different circumstances, and depends in a controlling degree on its judicial use in compounding diets.

1. Physiological or Feeding Value.

As no single plant or part of plant has been found to supply economically and efficiently, to any considerable extent, the wants of our various kinds of farm stock, it becomes a matter of first importance to learn how to supplement our leading farm crops to meet the divers wants of each kind. To secure the highest feeding value of each article of fodder is most desirable in the interest of good economy. The judicious selection of ingredients for a suitable and remunerative diet for our dairy stock obliges us, therefore, to study the value of fodder articles at our disposal from both standpoints.

To ascertain the chemical composition of a fodder ration, in connection with an otherwise carefully managed feeding experiment, enables us to recognize with more certainty the causes of the varying feeding effects of one and the same fodder article, when fed in different combinations. It furnishes also a most valuable guide in the selection of suitable commercial feed stuffs from known sources to supplement economically our home-raised fodder crops. Practical experience in feeding stock has so far advanced that it seems to need no further argument to accept it as a matter of fact that the efficiency of a fodder ration in the dairy does not depend, aside from its general or special adaptation, on the mere presence of more or less of certain prominent fodder articles, but on the presence of a proper quantity and a certain relative proportion of certain prominent constituents of plants which are known to be essential for a successful support of life and of the special functions of the dairy cow.

Investigations into the relations which the various promi-

nent constituents of plants bear to the support of animal life have rendered it advisable to classify them, in this connection, into three groups, — mineral constituents, and nitrogenous and non-nitrogenous organic constituents. For details regarding this matter, I have to refer to previous publications of the Station. (See Fourth Annual Report, pages 31–37.)

Numerous and extensive practical feeding experiments with most of our prominent fodder articles in various conditions, and with all kinds of farm live stock, have introduced the practice of reporting, in connection with the analysis of the chemist, also the result of careful feeding experiments as far as the various fodder articles have proved digestible, and were thus qualified for the support of the life and the functions of the particular kind of animal on trial. In stating the amount of the digestible portion of the fodder consumed in a feeding experiment, it has proved useful for comparing different fodder rations, etc., to make known by a distinct record the relative proportions which has been noticed to exist between the amount of its digestible, nitrogenous and non-nitrogenous organic constituents. This relation is expressed by the name of "nutritive ratio." An examination of the description of our feeding experiments will show, for instance, that the corn meal fed (1888) contained one part of digestible nitrogenous to 9.66 parts of digestible non-nitrogenous organic matter, making the customary allowance for the higher physiological value of the fat as compared with that of starch, sugar, etc. (2.5 times higher).

The "nutritive ratios" of the articles of feed consumed in 1888 are subsequently stated as follows: —

Corn meal,	1 : 9.66	English hay,	1 : 10.52
Wheat bran,	1 : 3.85	Dry corn fodder,	1 : 10.31
Gluten meal,	1 : 2.11	Stover,	1 : 9.3
		Corn ensilage,	1 : 8.8

The results of our own analyses of these fodder articles are here turned to account for the calculation of the above-stated "nutritive ratios."

It has been noticed that, as a general rule, growing

animals and milch cows require a richer food, — *i. e.*, a closer relation of digestible nitrogenous and non-nitrogenous organic constituents in their feed, — to do their best, than full-grown animals and moderately-worked horses and oxen. German investigators recommend a combination of fodder articles, in other respects suitable, which contains one part of nitrogenous organic constituents to 5.4 parts of digestible non-nitrogenous constituents.

2. *Commercial Value or Actual Cost of a Fodder Article.*

The composition of the various articles of food used in farm practice exerts a decided influence on the manurial value of the animal excretions resulting from their use in the diet of different kinds of farm live stock. The more potash, phosphoric acid, and in particular nitrogen, a fodder ingredient contains, the more valuable will be, under otherwise corresponding circumstances, the manurial residue left behind, after it has served its purpose as a constituent of the food consumed.

As the financial success in most farm managements depends in a considerable degree on the amount, the character and the cost of the manurial refuse material secured in connection with the special farm industry carried on, it needs no further argument to prove that the relations which exist between the composition of the fodder, and the value of the manure resulting, deserve the careful consideration of the farmer when devising an efficient and at the same time an economical diet for his live stock.

The question whether one or the other fodder mixture will prove ultimately, under otherwise corresponding circumstances, the cheapest one, can only be answered intelligently when both the original cost of the feed consumed and the value of the manurial residue subsequently obtained are duly considered.

An examination of the fodder articles used in connection with our investigations shows, for instance, the following relation between their first cost and the commercial value of their fertilizing constituents : —

	First cost.	Value of Fertilizing Constituents.
Corn meal, ...	$23 00	$7 19
Wheat bran, ...	23 00	12 31
Gluten meal, ...	27 00	17 49
English hay, ...	15 00	6 45
Corn ensilage, ...	2 75	1 31
Fodder corn, ...	5 00	4 77
Corn stover, ...	5 00	4 95
Carrots, ...	7 00	1 06
Lane's sugar beet, ...	5 00	1 60

A compilation of our own observations in this direction will be found at the close of our present report.

The close relation which quite necessarily exits in most farm managements between the system of cultivating the lands and the keeping of farm live stock for farm work, for the dairy and for the supply of food for the general market, imparts to the barn-yard manure a special if not a controlling importance as a valuable manurial resource. The barn-yard manure ought to remain, in a judicious system of mixed farming, not only the main reliance of the farmer for plant food, but also the cheapest manure at his disposal. The objections raised at times against a liberal use of barn-yard manure ought not to rest on its higher cost of production, when compared with other manurial substances in our market. The name, "barn-yard manure," is, however, too frequently used without any particular discrimination with reference to all kinds of manurial refuse obtained in connection with stock feeding and stock raising, which are frequently of widely differing composition. To approximate even fairly the comparative value of two samples obtained on different farms remains a hopeless task as long as a more definite information regarding the following points is wanting: —

(1.) The character of the fodder consumed.

(2.) The kind, the age and the function of the animal which served for its production.

(3.) The nature and the quantity of the material which served for the absorption of the animal excretions.

(4.) The care bestowed upon collecting and preserving the entire liquid and solid excretions.

Assuming, for our present purpose, in both instances, identical conditions, as far as the kind of animal, the mode of collecting and the care of keeping the manure are concerned, it will be apparent that the relative values of the two kinds of barn-yard manure stand essentially in a direct relation to the amount of nitrogen, potash, phosphoric acid, etc., which was contained in the feed consumed.

The loss of fertilizing constituents contained in the fodder of milch cows, in consequence of the production of milk, varies quite naturally more or less in case of different cows, as well as of one and the same animal at its different stages of milk production. Whether the whole milk or only the cream is sold off from the farm deserves here not less serious consideration.

We have adopted thus far in our calculation a loss of twenty per cent., which may be considered quite a liberal allowance in case of a fair average production of milk, and where the whole milk is sold.

1886. — From the description of our earlier feeding experiments with milch cows (see Fourth Annual Report, page 11), it may be observed that the relations of the digestible nitrogenous and non-nitrogenous organic constituents in the different combinations of fodder articles which constituted, during the various feeding periods, the daily diet of the cows, varied on that occasion from 1 : 6.7 to 1 : 10.17. The closer relation was obtained by feeding, on an average, daily, —

3¼ lbs. of wheat bran, 15 lbs. of hay, 40 lbs. of Lane's sugar beet,	Nutritive ratio, 1 : 6.7.

and the wider ratio by feeding daily, on an average, —

3¼ lbs. of corn meal, 5 lbs. of hay, 41¾ lbs. of corn ensilage,	Nutritive ratio, 1 : 10.17.

1887. — As most well-conducted experiments with dairy cows endorse the use of a diet which has a closer relation

between its digestible organic nitrogenous and non-nitrogenous constituents than either one of the above-stated two fodder rations used by us, it was decided to try fodder combinations which, in consequence of the addition of some concentrated commercial fodder article, would contain a larger amount of digestible nitrogenous substances. The gluten meal was selected for that purpose. The same coarse fodder articles — English hay, corn ensilage, corn stover and roots (carrots) — were used in most cases in different quantities and combinations with equal weights of corn meal, wheat bran and gluten meal. The relations between the two above-stated important groups of fodder constituents varied in the different diets used from 1 : 5 9 to 1 : 7.9. The closer relation was obtained by feeding daily, on an average, —

3¼ lbs. of corn meal,	Nutritive ratio, 1 : 5.9.
3¼ lbs. of wheat bran,	
3¼ lbs of gluten meal,	
10 lbs. of hay,	
35 lbs. of carrots,	

and the wider ratio by feeding, on an average, —

3¼ lbs. of corn meal,	Nutritive ratio, 1 : 7.9.
3¼ lbs. of wheat bran,	
25 lbs. of hay,	

The entire feeding experiment (I) was subdivided into eight distinctly different feeding periods; the same number as on the preceding occasion, for the same length of time — seven months.

The dry corn fodder, the ensilage and the roots were cut before being offered as feed.

The yield of milk decreased, although at a different rate, in the case of different animals as time advanced. The shrinkage in the daily yield of milk amounted, at the end of the experiment, to from 3.2 quarts to 4.9 quarts in case of different cows. The gradual decline in the entire milk record of every cow is only once broken, namely, during the sixth feeding period, February 7 to February 21, when the yield of milk shows an increase of from .7 to 1.9 quarts per day, as compared with that of the preceding period. This change for the better was noticed when ten pounds of

hay and thirty-four pounds of carrots were used, under otherwise corresponding circumstances, as a substitute for five pounds of hay and twenty-nine pounds of corn ensilage. The amount of dry vegetable matter contained in the hay fed with roots and in the hay fed with corn ensilage was practically the same in both instances. The feed of the sixth feeding period, containing carrots as an ingredient, is thus the most nutritive and also the most expensive.

The results of the experiment led us to the following conclusions: —

The nutritive value of our dry corn fodder (stover) compares well with that of an average quality of English hay; the same may be said of good corn ensilage in place of from one-half to two-thirds of the customary amount of hay.

The nutritive value of our dry corn fodder (stover) and of a good corn ensilage, taking into consideration pound for pound of the dry vegetable matter they contain, has proved in our case fully equal, if not superior, to that of the average English hay.

The nutritive feeding value of carrots, taking into consideration pound for pound of the dry vegetable matter they contain, exceeds that of the corn ensilage as an ingredient of the daily diet, in place of a part (one-half) of the hay fed. The conclusions thus far stated are in full agreement with those pointed out in our earlier experiments.

The influence of the various diets used on the quality of the milk seems to depend in a controlling degree on the constitutional characteristics of the animal on trial. The effect is not unfrequently in our case the reverse in different animals depending on the same diet.

The total cost of the feed for the production of milk is lowest whenever corn fodder or corn ensilage have replaced, in the whole or in part, English hay, under otherwise corresponding circumstances.

The net cost of feed consumed for the production of one quart of milk during the various feeding periods, varies as widely as from .34 cents to 1.6 cents in case of the same cow. The net cost of the feed is obtained by deducting eighty per cent. of the value of the fertilizing constituents it contains.

The manurial value of the feed consumed during the entire feeding experiment, deducting twenty per cent. for the amount of fertilizing constituents lost in the production of milk, is, at the current market rates, in every instance, more than equal to one-third of the original cost of the feed.

To avoid misconstruction regarding the statement of net cost of milk used in our description, I state once more that it does not include expenses of labor, housing, interest on investment, etc., but means merely net cost of feed after deducting eighty per cent. of its manurial value. (For details, see Fifth Annual Report, pages 11–34.)

1888. — To verify as far as practicable the above-stated conclusions, a new series of observations was decided upon. The course adopted was essentially the same as in the preceding year. English hay, fodder corn, corn ensilage and corn stover served as coarse fodder articles; and corn meal, corn and cob meal, wheat bran and gluten meal as the supplementary feed stuffs to secure the desired relative proportion of digestible nitrogenous and non-nitrogenous substances in the daily fodder rations. The repetition of a comparative test between roots and corn ensilage was left over for another season, when a larger supply of sugar beets and carrots would render the trial more decisive. The fodder corn, corn ensilage and corn stover were cut to an even length ($1\frac{1}{2}$–2 inches) before fed. The daily average amount of fodder corn left behind unconsumed was 5.55 pounds and that of corn stover and ensilage, 3 pounds.

Six cows, grades, served in the experiment, which was subdivided into seven feeding periods, extending over a period of four and one-half months. The same quantity of corn and cob meal, wheat bran and gluten meal (three and one-quarter pounds each) was fed daily from the beginning to the close of the trial. Corn ensilage was fed in different proportions with one-half or one-fourth of English hay. Fodder corn and corn stover were fed most of the time by themselves.

The nutritive value of the different diets used has been quite close, varying from 1:5 5 to 1:6.1. The adopted rates of digestibility of the fodder ingredients are those which have been published of late by E. Wolff. They are

in most instances the average values of a series of actual tests, and are for this reason applicable for mere economical questions. As soon as our home observations shall have furnished sufficient material to enable us to establish reliable average values, they will be substituted.

Local Market Value of Feed used in our Calculations.

Corn meal,	$23 00	English hay,	$15 00
Corn and cob meal,	20 70	Fodder corn,	5 00
Wheat bran,	23 00	Corn ensilage,	2 75
Gluten meal,	27 00	Corn stover,	5 00

An examination of the subsequent tabular statement of the details of the late experiment cannot fail to show that the conclusions drawn from our preceding observation in this direction are in the main fully sustained.

The high nutritive value of fodder corn, good corn ensilage and corn stover, as compared with that of English hay, counting in all instances pound for pound of dry vegetable matter, is fully confirmed. The general condition of the animals on trial, as well as the quality of the milk, point in that direction.

The daily yield of milk decreased gradually, apparently at a normal rate, during the progress of the experiment. The shrinkage in the yield of milk amounted, at the close of the trial, in the case of different cows of different milking periods, to from 1.6 to 4 quarts per day. The weight of the cows had decreased in three cases, and had increased in three.

The first cost of feed for the production of one quart of milk in case of the same cow, is, as a rule, from one-half to one cent less per quart wherever fodder corn, corn ensilage or corn stover have replaced in part or in whole the English hay. The first cost of feed for the production of one quart of milk differs, for obvious reasons, quite seriously in case of the same diet as far as different animals are concerned. This difference stands in a direct relation to the daily yield of milk; the less the latter, the higher the cost of the feed. A few results taken from our subsequent records may convey some more definite idea regarding this important circumstance.

Fodder rations:	Fodder corn,	18–19 lbs.
	Corn and cob meal,	3¼ lbs.
	Wheat bran,	3¼ lbs.
	Gluten meal,	3¼ lbs.

	Daily Yield of Milk.	First cost of feed.	Net cost of feed.
Daisy,	17.5 qts.	1.01 cts. per qt.	.50 cts. per qt.
Melia,	12.7 "	1.28 " "	.66 " "
Eva,	6.1 "	2.64 " "	1.39 " "

Fodder rations:	English hay,	20 lbs.
	Corn and cob meal,	3¼ lbs.
	Wheat bran,	3¼ lbs.
	Gluten meal,	3¼ lbs.

	Daily Yield of Milk.	First cost of feed.	Net cost of feed.
Daisy,	13.5 qts.	1.97 cts per qt.	1.28 cts. per qt.
Melia,	10.9 "	2.44 " "	1.59 " "
Eva,	5.6 "	4.74 " "	3.09 " "

The net cost of feed is obtained by deducting eighty per cent. of the commercial value of the fertilizing constituents it contains from its first cost. The manurial value of the feed consumed during the feeding experiments, after deducting twenty per cent. for the amount of fertilizing constituents lost in the production of milk, is at current market prices in every instance more than one-third of the original cost of the feed.

For further details, consult the following record: —

FEEDING RECORD.

MAY: *Age, 7 years; Grade, Jersey; Last Calf, June 6, 1887.*

Feeding Periods.	Feed Consumed (pounds) per Day.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.					
1888.													
Jan. 8 to Jan. 16,	3.25	–	3.25	3.25	18.89	–	–	–	25.49	10.8	2.36	1:6.1	845
Jan. 21 to Feb. 6,	–	3 25	3.25	3.25	20.00	–	–	–	26.46	12.3	2.15	1:5.9	862
Feb. 13 to Feb. 26,	–	3.25	3.25	3.25	–	20.41	–	–	23.95	11.0	2.18	1:6.2	825
March 1 to March 13,	–	3.25	3.25	3.25	10.00	–	21.71	–	22.48	11.6	1.94	1:5.6	848
March 20 to April 4,	–	3.25	3.25	3.25	5.00	–	36.78	–	21.45	10.6	2.02	1:5.5	828
April 20 to April 30,	–	3.25	3.25	3.25	–	–	–	13.98	19.93	10.1	1.97	1:5.5	820
May 9 to May 15,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	10.6	2.50	1:5.9	862

MINNIE: *Age, 8 years; Grade, Ayrshire; Last Calf, May 3, 1887.*

Feeding Periods.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 8 to Jan. 16,	3.25	–	3.25	3.25	18.86	–	–	–	25.47	12.0	2.12	1:6.1	993
Jan. 21 to Feb. 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	12.7	2.08	1:5.9	993
Feb. 13 to Feb 26,	–	3.25	3.25	3.25	–	17.71	–	–	21.93	11.3	1.94	1:5.9	960
March 1 to March 13,	–	3.25	3.25	3.25	10.00	–	21.71	–	22.48	12.1	1.86	1:5 6	955
March 20 to April 4,	–	3 25	3.25	3.25	5.00	–	29.45	–	19.78	10.9	1.81	1:5.4	949
April 20 to April 30,	–	3.25	3.25	3.25	–	–	–	11.20	17.68	10.2	1.73	1:5.2	870
May 9 to May 15,	–	3.25	3.25	3.25	20.00	–	–	–	26.46	10.5	2.52	1:5.9	862

FEEDING RECORD — *Continued.*

MELIA: *Age, 10 years; Grade, Dutch; Last Calf, Aug. 5, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day. Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 8 to Jan. 16, . .	3.25	–	3.25	3.25	18.33	–	–	–	24.99	13.5	1.85	1 : 6.1	993
Jan. 21 to Feb. 6, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	14.6	1.81	1 : 5.9	995
Feb. 13 to Feb. 26, . .	–	3.25	3.25	3.25	–	18.93	–	–	22.84	12.7	1.80	1 : 6.0	954
March 1 to March 13, . .	–	3.25	3.25	3.25	10.00	–	21.78	–	22.50	12.5	1.80	1 : 5.6	973
March 20 to April 4, . .	–	3.25	3.25	3.25	5.00	–	32.05	–	20.37	11.8	1.73	1 : 5.5	936
April 20 to April 30, . .	–	3.25	3.25	3.25	–	–	–	13.75	19.75	11.2	1.76	1 : 5.5	925
May 9 to May 15, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	10.9	2.43	1 : 5.9	969

EVA: *Age, 8 years; Grade, Jersey; Last Calf, Jan. 6, 1887.*

FEEDING PERIODS.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 6 to Jan. 16, . .	3.25	–	3.25	3.25	18.89	–	–	–	25.49	7.0	3.64	1 : 6.1	988
Jan. 21 to Feb. 6, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	7.2	3.68	1 : 5.9	1,008
Feb. 13 to Feb. 26, . .	–	3.25	3.25	3.25	–	18.19	–	–	22.29	6.1	3.65	1 : 6.0	997
March 20 to April 4, . .	–	3.25	3.25	3.25	5.00	–	31.80	–	20.32	5.5	3.69	1 : 5.4	1,022
April 20 to April 30, . .	–	2.35	3.25	3.25	–	–	–	13.02	19.16	5.7	3.36	1 : 5.5	1,055
May 9 to May 15, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	5.6	4.73	1 : 5.9	1,143

FEEDING RECORD — *Concluded.*

LIZZIE: *Age, 6 years; Native; Last Calf, Feb. 1, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per Day.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.					
1888.													
Jan. 8 to Jan. 16, . .	3.25	–	3.25	3.25	18.31	–	–	–	25.08	9.4	2.67	1:6.1	1,045
Jan. 21 to Feb. 6, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	10 6	2.50	1:5.9	1,055
Feb. 13 to Feb. 26, . .	–	3.25	3.25	3.25	–	20.18	–	–	23.74	8.2	2.90	1:6.1	1,037
March 1 to March 13, . .	–	3.25	3.25	3.25	10.00	–	18.92	–	21.85	9.2	2.38	1:5.5	1,040
March 20 to April 4, . .	–	3.25	3.25	3.25	5.00	–	26.42	–	19.09	8.6	2.22	1:5.3	1,073
April 20 to April 30, . .	–	3.25	3.25	3.25	–	–	–	12.70	18.90	8.7	2.17	1:5.4	1,055
May 9 to May 15, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	7.9	3.35	1:5.9	1,091

DAISY: *Age, 5 years; Grade, Durham; Last Calf, Jan. 5, 1888.*

FEEDING PERIODS.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 21 to Feb. 6, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	19.2	1.38	1:5.9	1,148
Feb. 13 to Feb. 26, . .	–	3.25	3.25	3.25	–	25.00	–	–	27.40	17.5	1.56	1:6.5	1,102
March 1 to March 13, . .	–	3.25	3.25	3.25	10.00	–	34.46	–	25.38	17.0	1.49	1:5.8	1,068
March 20 to April 4, . .	–	3 25	3.25	3.25	5.00	–	47.36	–	23.86	14.3	1.67	1:5.8	1,084
April 20 to April 30, . .	–	3.25	3.25	3.25	–	–	–	15.32	21.02	13.6	1.55	1:5.7	1,100
May 9 to May 15, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	13.5	1.96	1:5.9	1,102

Total Cost of Feed per Quart of Milk.

May.

Feeding Periods.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Jan. 8 to Jan. 16,	97.2	10.8	29.25	–	29.25	29.25	170.01	–	–	–	$2 34	2.41
Jan. 21 to Feb. 6,	209.1	12.3	–	55.25	55.25	55.25	340.00	–	–	–	4 51	2.16
Feb. 13 to Feb. 26,	154.0	11.0	–	45.50	45.50	45.50	–	285.74	–	–	2 33	1.51
March 1 to March 13,	162.4	11.6	–	42.25	42.25	42.25	130.00	–	282.23	–	2 87	1.77
March 20 to April 4,	169.6	10.6	–	52.00	52 00	52.00	80.00	–	588.18	–	3 26	1.93
April 20 to April 30,	111 1	10.1	–	35.75	35.75	35.75	–	–	–	143.22	1 65	1.59
May 9 to May 15,	74.2	10.6	–	22.75	22.75	22.75	140 00	–	–	–	1 86	2.51

Minnie.

Feeding Periods.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.												
Jan. 8 to Jan. 16,	108.0	12.0	29.25	–	29.25	29.25	169.74	–	–	–	$2 34	2.17
Jan. 21 to Feb. 6,	215.9	12.7	–	55.25	55.25	55.25	340.00	–	–	–	4 51	2 09
Feb. 13 to Feb. 26,	158 2	11.3	–	45.50	45.50	45.50	–	217.94	–	–	2 23	1.41
March 1 to March 13,	157.3	12.1	–	42.25	42.25	42.25	130.00	–	282.23	–	2 87	1.82
March 20 to April 4,	174.1	10.9	–	52.00	52.00	52.00	80.00	–	471 20	–	3 10	1.78
April 20 to April 30,	112.2	10.2	–	35.75	35.75	35.75	–	–	–	139.70	1 57	1.40
May 9 to May 15,	73.5	10.5	–	22.75	22.75	22.75	140.00	–	–	–	1 86	2 53

TOTAL COST OF FEED PER QUART OF MILK — Continued.

Melia.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs.	Lbs.		Cents.
Jan. 8 to Jan. 16, . .	121.5	13.5	29.25	–	29.25	29.25	164.97	–	–	–	$2 30	1.89
Jan. 21 to Feb. 6, . .	248.2	14.6	–	55.25	55.25	55.25	340.00	–	–	–	4 51	1.82
Feb. 13 to Feb. 26, . .	177.8	12.7	–	45.50	45.50	45.50	–	265.02	–	–	2 27	1.28
March 1 to March 13, . .	162.5	12.5	–	42 25	42.25	42.25	130.00	–	283.14	–	2 87	1.77
March 20 to April 4, . .	188.8	11 8	–	52.00	52.00	52.00	80.00	–	512.80	–	3 16	1.67
April 20 to April 30, . .	123.2	11 2	–	35.75	35.75	35.75	–	–	–	168.52	1 74	1.33
May 9 to May 15, . .	76.3	10.9	–	22.75	22.75	22.75	140.00	–	–	–	1 86	2.44

Eva.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.												
Jan. 8 to Jan. 16, . .	63.0	7.0	29.25	–	29.25	29.25	170.01	–	–	–	$2 34	3.71
Jan. 21 to Feb. 6, . .	122.4	7.2	–	55.25	55.25	55.25	340.00	–	–	–	4 51	3.68
Feb. 13 to Feb. 26, . .	85.1	6.1	–	45.50	45.50	45.50	–	254.66	–	–	2 25	2.64
March 20 to April 4, . .	88.0	5.5	–	52.00	52.00	52.00	80.00	–	508.80	–	3 15	3.58
April 20 to April 30, . .	62 7	5.7	–	35.75	35.75	35.75	–	–	–	153.78	1 62	2.58
May 9 to May 15, . .	39.2	5.6	–	22.75	22.75	22.75	140.00	–	–	–	1 86	4.74

TOTAL COST OF FEED PER QUART OF MILK — Concluded.

Lizzie.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Jan. 8 to Jan. 16, . .	84.6	9.4	29.25	–	29.25	29.25	164.79	–	–	–	$2 30	2.72
Jan. 21 to Feb. 6, . .	180.2	10.6	–	55.25	55.25	55.25	340.00	–	–	–	4 51	2.50
Feb. 13 to Feb. 26, . .	114 8	8.2	–	45.50	45.50	45.50	–	282.52	–	–	2 32	2.02
March 1 to March 13, . .	119.6	9.2	–	42.25	42.25	42.25	130.00	–	245.96	–	2 81	2.35
March 20 to April 4, . .	137.6	8.6	–	52.00	52.00	52.00	80.00	–	422.72	–	3 03	2 20
April 20 to April 30, . .	95.7	8.7	–	35.75	35 75	35.75	–	–	–	123.20	1 61	1.68
May 9 to May 15, . .	55.3	7.9	–	22.75	22.75	22.75	140.00	–	–	–	1 86	3.36

Daisy.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.												
Jan. 21 to Feb. 6, . .	326.4	19.2	–	55.25	55.25	55.25	340.00	–	–	–	$4 51	1.38
Feb. 13 to Feb. 26, . .	245.0	17.5	–	45.50	45 50	45.50	–	350.00	–	–	2 49	1.01
March 1 to March 13, . .	221.0	17.0	–	42.25	42.25	42.25	130.00	–	447.98	–	3 10	1.40
March 20 to April 4, . .	228.8	14.3	–	52.00	52.00	52.00	80.00	–	757.76	–	3 50	1.53
April 20 to April 30, . .	149.6	13.6	–	35.75	35.75	35.75	–	–	–	151.25	1 69	1.13
May 9 to May 15, . .	94.5	13.5	–	22.75	22.75	22.75	140.00	–	–	–	1 86	1.97

SUMMARY OF NET COST OF FEED FOR EACH COW DURING SUCCEEDING PERIODS

PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during the Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
					Cents.	Lbs.
1. May,	$2 34	$1 03	$0 82	$1 52	1.56	860
Minnie,	2 34	1 03	82	1 52	1.41	985
Melia,	2 30	1 02	82	1 48	1.22	985
Eva,	2 34	1 03	82	1 52	2.41	985
Lizzie,	2 30	1 02	82	1 48	1.75	1,025
2. May,	4 51	1 98	1 58	2 93	1.40	880
Minnie,	4 51	1 98	1 58	2 93	1.36	1,005
Melia,	4 51	1 98	1 58	2 93	1.19	1,005
Eva,	4 51	1 98	1 58	2 93	2.39	1,030
Lizzie,	4 51	1 98	1 58	2.93	1.63	1,060
Daisy,	4 51	1 98	1 58	2 93	.90	1,145
3. May,	2 33	1 42	1 14	1 19	.77	820
Minnie,	2 23	1 33	1 06	1 17	.74	965
Melia,	2 27	1 37	1 10	1 17	.66	965
Eva,	2 25	1 34	1 07	1 18	1.39	1,010
Lizzie,	2 32	1 41	1 13	1 19	1.04	1,060
Daisy,	2 49	1 57	1 26	1 23	.50	1,105
4. May,	2 87	1 29	1 03	1 84	1.13	840
Minnie,	2 87	1 29	1 03	1 84	1.17	950
Melia,	2 87	1 29	1 03	1 84	1.13	975
Lizzie,	2 81	1 27	1 02	1 79	1.50	1,050
Daisy,	3 10	1 41	1 13	1 97	.89	1,060
5. May,	3 26	1 50	1 20	2 06	1.21	825
Minnie,	3 10	1 42	1 14	1 96	1.12	942
Melia,	3 16	1 45	1 16	2 00	1.06	897
Eva,	3 15	1 45	1 16	1 99	2.26	1,000
Lizzie,	3 03	1 39	1 11	1 92	1.40	1,045
Daisy,	3 50	1 62	1 30	2 20	.96	1,091
6. May,	1 65	93	74	91	.82	804
Minnie,	1 57	92	74	83	.74	922
Melia,	1 74	1 00	80	94	.76	935
Eva,	1 62	96	77	85	1.35	1,153
Lizzie,	1 61	88	70	91	.95	1,043
Daisy,	1 69	95	76	93	.62	1,046
7. May,	1 86	81	65	1 21	1.63	860
Minnie,	1 86	81	65	1 21	1.65	945
Melia,	1 86	81	65	1 21	1.59	972
Eva,	1 86	81	65	1 21	3.09	1,105
Lizzie,	1 86	81	65	1 21	2.19	1,087
Daisy,	1 86	81	65	1 21	1.28	1,103

Summary.

May.

Total amount of milk produced during the above records (87 days),	977.6 qts.
Total cost of feed per quart of milk produced,	1.93 cts.
Manurial value left behind per quart of milk produced,	.73 cts.
Net cost per quart of milk produced,	1.20 cts.

Minnie.

Total amount of milk produced during the above records (87 days),	999.5 qts.
Total cost of feed per quart of milk produced,	1.85 cts.
Manurial value left behind per quart of milk produced,	.70 cts.
Net cost per quart of milk produced,	1.15 cts.

Melia.

Total amount of milk produced during the above records (87 days),	1,098.3 qts.
Total cost of feed per quart of milk produced,	1.70 cts.
Manurial value left behind per quart of milk produced,	.65 cts.
Net cost per quart of milk produced,	1.05 cts.

Eva.

Total amount of milk produced during the above records (74 days),	460.4 qts.
Total cost of feed per quart of milk produced,	3.42 cts.
Manurial value left behind per quart of milk produced,	1.31 cts.
Net cost per quart of milk produced,	2.11 cts.

Lizzie.

Total amount of milk produced during the above records (87 days),	787.8 qts.
Total cost of feed per quart of milk produced,	2.34 cts.
Manurial value left behind per quart of milk produced,	.90 cts.
Net cost per quart of milk produced,	1.44 cts.

Daisy.

Total amount of milk produced during the above records (78 days),	1,265.3 qts.
Total cost of feed per quart of milk produced,	1.36 cts.
Manurial value left behind per quart of milk produced,	.53 cts.
Net cost per quart of milk produced,	.83 cts.

Manurial Value of Feed.

May.

Feeding Periods.	Total Cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
1888.					Cents.	Lbs.
Jan. 8 to Jan. 16,	$2 34	$1 03	$0 82	$1 52	1.56	860
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	1.40	880
Feb. 13 to Feb. 26,	2 33	1 42	1 14	1 19	.77	820
Mar. 1 to Mar. 13,	2 87	1 29	1 03	1 84	1.13	840
Mar. 20 to Apr. 4,	3 26	1 50	1 20	2 06	1.21	825
Apr. 20 to Apr. 30,	1 65	93	74	91	.82	804
May 9 to May 15,	1 86	81	65	1 21	1.63	860
Total, . . .	$18 82	$8 96	$7 16	$11 66	–	–

Minnie.

1888.						
Jan. 8 to Jan. 16,	$2 34	$1 03	$0 82	$1 52	1.41	985
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	1.36	1,005
Feb. 13 to Feb. 26,	2 23	1 33	1 06	1 17	.74	965
Mar. 1 to Mar. 13,	2 87	1 29	1 03	1 84	1.17	950
Mar. 20 to Apr. 4,	3 10	1 42	1 14	1 96	1.12	942
Apr. 20 to Apr. 30,	1 57	92	74	83	.74	922
May 9 to May 15,	1 86	81	65	1 21	1.65	945
Total, . . .	$18 48	$8 78	$7 02	$11 46	–	–

Melia.

1888.						
Jan. 8 to Jan. 16,	$2 30	$1 02	$0 82	$1 48	1.22	985
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	1.19	1,005
Feb. 13 to Feb. 26,	2 27	1 37	1 10	1 17	.66	965
Mar. 1 to Mar. 13,	2 87	1 29	1 03	1 84	1.13	975
Mar. 20 to Apr. 4,	3 16	1 45	1 16	2 00	1.06	897
Apr. 20 to Apr. 30,	1 74	1 00	80	94	.76	935
May 9 to May 15,	1 86	81	65	1 21	1.59	972
Total, . . .	$18 71	$8 92	$7 14	$11 57	–	–

Manurial Value of Feed — Concluded.

Eva.

FEEDING PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
1888.					Cents.	Lbs.
Jan. 8 to Jan. 16,	$2 34	$1 03	$0 82	$1 52	2.41	985
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	2.39	1,030
Feb. 13 to Feb. 26,	2 25	1 34	1 07	1 18	1.39	1,010
Mar. 20 to Apr. 4,	3 15	1 45	1 16	1 99	2.26	1,000
Apr. 20 to Apr. 30,	1 62	96	77	85	1.35	1,153
May 9 to May 15,	1 86	81	65	1 21	3.09	1,105
Total, . . .	$15 73	$7 57	$6 05	$9 68	–	–

Lizzie.

1888.						
Jan. 8 to Jan. 16,	$2 30	$1 02	$0 82	$1 48	1.75	1,025
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	1.63	1,060
Feb. 13 to Feb. 26,	2 32	1 41	1 13	1 19	1.04	1,060
Mar. 1 to Mar. 13,	2 81	1 27	1 02	1 79	1.50	1,050
Mar. 20 to Apr. 4,	3 03	1 39	1 11	1 92	1.40	1,045
Apr. 20 to Apr. 30,	1 61	88	70	91	.95	1,043
May 9 to May 15,	1 86	81	65	1 21	2.19	1,087
Total, . . .	$18 44	$8 76	$7 01	$11 43	–	–

Daisy.

1888.						
Jan. 21 to Feb. 6,	$4 51	$1 98	$1 58	$2 93	0.90	1,145
Feb. 13 to Feb. 26,	2 49	1 57	1 26	1 23	.50	1,105
Mar. 1 to Mar. 13,	3 10	1 41	1 13	1 97	.89	1,060
Mar. 20 to Apr. 4,	3 50	1 62	1 30	2 20	.96	1,091
Apr. 20 to Apr. 30,	1 69	95	76	93	.62	1,046
May 9 to May 15,	1 86	81	65	1 21	1.28	1,103
Total, . . .	$17 15	$8 34	$6 68	$10 47	–	–

Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents per pound; potassium oxide, 4¼ cents per pound.

[Per cent.]

	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Fodder Corn.	Hay.	Ensilage.	Corn Stover.
Nitrogen,	1.796	1.453	2.780	5.120	.995	1.250	.289	1.119
Phosphoric acid,	.744	.688	1.857	.297	.201	.464	.112	:354
Potassium oxide,	.435	.548	1 071	.030	1.465	2.085	.264	.975
Valuation per 2,000 lbs.,	$7 19	$6 09	$12 31	$17 28	$4 77	$6 45	$1 31	$4 95

Analyses of Milk.

[Per cent.]

1888.	Jan. 17.	Jan. 31.	Feb. 24.	Mar. 9.	Mar. 29.	April 11.	April 24.	May 8.
May.								
Solids,	14.04	13.64	14.30	14.18	14.05	13.76	13 91	14.36
Fat,	4.13	3.64	3.91	3.55	3.95	2.64	4.18	4.71
Solids not fat,	9.91	10.00	10.39	10.63	10.10	11.12	9.73	9.65
Minnie.								
Solids,	13.61	13.86	14.55	13.76	13.36	13.84	13.28	13.90
Fat,	3.68	4.21	3.90	3.65	3.54	3.43	4.33	4.62
Solids not fat,	9.93	9.65	10.65	10.11	9.82	10.41	8.95	9.28
Melia.								
Solids,	12.79	13.19	13.26	12.43	12.15	13.26	13.90	13.12
Fat,	3.30	3.57	3.13	2.48	3.21	3.19	4.47	3.79
Solids not fat,	9.49	9.62	10.13	9.95	8.94	10.07	9.43	9.33
Eva.								
Solids,	16.38	16.60	15.97	16.04	15.79	16.44	16.28	16.70
Fat,	5.45	6.00	5.17	4.84	5.54	4.77	6.39	6.46
Solids not fat,	10.93	10.60	10.80	11.20	10.25	11.67	9.89	10.24
Lizzie.								
Solids,	13.39	13.77	13.20	13.27	14.02	12.89	13 35	13.76
Fat,	3.68	4.46	3.15	3.21	4.32	2.87	4.71	4.61
Solids not fat,	9.71	9.31	10.05	10.06	9.70	10.02	8.64	9.15
Daisy.								
Solids,	13.34	11.96	12.63	13.22	12.94	12.95	12.09	12.43
Fat,	4.23	3.09	2.73	3.55	3.54	3.18	3.86	3.78
Solids not fat,	9.11	8.87	9.90	9.67	9.40	9.77	8.23	8.65

Corn Meal (Average).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.08	261.60	–	–	1 : 9.66
Dry matter,	86.92	1,738.40	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	1.66	33.20	–	–	
" cellulose,	3.49	69.80	23.73	34	
" fat,	4.97	99.40	75.54	76	
" protein (nitrogenous matter),	10.39	207.80	176.63	85	
Non-nitrogenous extract matter,	79.49	1,589.80	1,494.41	94	
	100.00	2,000.00	1,770.41	–	

Corn and Cob Meal (Average).

	Per cent.
Moisture at 100° C.,	13.69
Dry matter,	86.31
	100.00
Analysis of dry matter.	
Crude ash,	1.68
" cellulose,	7.75
" fat,	3.67
" protein (nitrogenous matter),	9.13
Non-nitrogenous extract matter,	77.77
	100.00

Nutritive ratio, 8.8.

Wheat Bran (Average).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.14	222.80	–	–	1 : 3.85
Dry matter,	88.86	1,777.20	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	6.59	131.80	–	–	
" cellulose,	12.80	256.00	51.20	20	
" fat,	6.00	120.00	96.00	80	
" protein (nitrogenous matter),	17.72	354.40	311.87	88	
Non-nitrogenous extract matter,	56.89	1,137.80	910.24	80	
	100.00	2,000.00	1,369.31	–	

Gluten Meal (Average).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.77	195.40	–	–	1 : 2.11
Dry matter,	90.23	1,804.60	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	.93	18.60	–	–	
" cellulose,	4.60	92.00	31.28	34	
" fat,	6.63	132.60	100.78	76	
" protein (nitrogenous matter),	35.43	708.60	602.31	85	
Non-nitrogenous extract matter,	52.41	1,048.20	985.31	94	
	100.00	2,000.00	1,719.68	–	

HAY.

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.78	215.60	–	–	
Dry matter,	89.22	1,784.40	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	7.11	142.20	–	–	
" cellulose,	35.55	711.00	412.38	58	1 : 10.52
" fat,	2.63	52.60	24.20	46	
" protein (nitrogenous matter),	8.75	175.00	99.75	57	
Non-nitrogenous extract matter,	45.96	919.20	579.10	63	
	100.00	2,000.00	1,115.43	–	

FODDER CORN (DRY).

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	24.87	497.40	–	–	
Dry matter,	75.13	1,502.60	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	5.14	102.80	–	–	
" cellulose,	22.26	445.20	320.60	72	1 : 10.31
" fat,	2.62	52.40	39.30	75	
" protein (nitrogenous matter),	8.28	165.60	120.89	73	
Non-nitrogenous extract matter,	61.70	1,234.00	826.78	67	
	100.00	2,000.00	1,307.57	–	

Corn Ensilage.

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	77.24	1,544.80	–	–	1:8.8
Dry matter,	22.76	455.20	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	4.94	98.80	–	–	
" cellulose,	20.66	413.20	297.50	72	
" fat,	3.15	63.00	47.25	75	
" protein (nitrogenous matter),	9.67	193.40	141.19	73	
Non-nitrogenous extract matter,	61.58	1,231.60	825.17	67	
	100.00	2,000.00	1,311.11	–	

Corn Stover.

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	19.07	381.40	–	–	1:9.3
Dry matter,	80.93	1,618.60	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	4 22	84.40	–	–	
" cellulose,	20.93	418.60	301.39	72	
" fat,	2.63	52.60	39.45	75	
" protein (nitrogenous matter),	9.17	183.40	133.88	73	
Non-nitrogenous extract matter,	63.05	1,261.00	844.87	67	
	100.00	2,000.00	1,319.59	–	

II. Feeding Experiments with Milch Cows: Green Crops v. English Hay.

The preceding annual report contains a record of feeding experiments with milch cows, in which some noted green crops were used in place of English hay.

1887. — A mixed crop of green oats and vetch, of Southern cow-pea and of serradella, served in that connection.

Five cows were engaged in the trial. Two cows were fed with a daily fodder ration consisting of corn meal, $3\frac{1}{4}$ pounds (2 quarts); wheat bran, $3\frac{1}{4}$ pounds (4 quarts); English hay, 20 to 25 pounds.

The excess of hay left over was weighed back, and subsequently deducted from the original quantity. Three cows received periodically the above-stated daily rations and alternately the following: corn meal, $3\frac{1}{4}$ pounds; wheat bran, $3\frac{1}{4}$ pounds; English hay, 5 pounds; and as much of either green vetch and oats, green Southern cow-pea or green serradella, as the individual animal would consume. They consumed per day, on an average, from 64 to 65 pounds of green vetch and oats; of green Southern cow-peas, 96 to 97 pounds; and in case of green serradella, from 97 to 98 pounds. The feeding of the green crop commenced in every instance with the beginning of the blooming period.

The feeding of the different green fodders, in place of three-fourths of the customary daily rations of English hay, gave, on the whole, very satisfactory results. For details, we have to refer to the Fifth Annual Report of the Station.

1888. — The experiment has been repeated with some modifications during the past season. A mixed crop of vetch and oats and one of Southern cow-pea were raised for that purpose. (See record of field C. in this report.)

The quantity of green fodder fed at stated times is somewhat less in pounds than in last year's trial, on account of the addition of gluten meal to our last year's fodder ration.

The daily green fodder ration consisted of corn meal, $3\frac{1}{4}$ pounds; wheat barn, $3\frac{1}{4}$ pounds; gluten meal, $3\frac{1}{4}$ pounds; English hay, 5 pounds; and as much of vetch and oats or cow-pea as the animal would consume, which amounted in

the case of green vetch and oats to from 54 to 68 pounds, and in that of green Southern cow-peas from 70 to 80 pounds.

The nutritive ratio of the green fodder diet was a closer one than on former occasions, varying from 1 : 4.5 to 1 : 5.5. The nutritive effect was very satisfactory, for the animals, without exception, maintained their original weight; the yield of milk was in every instance somewhat raised, and the quality of the milk was equal to the best, as far as one and the same animal was concerned.

Five cows, grades, were turned to account in the trial. The net cost of the feed for the production of one quart of milk was in most instances lower than in case of a whole English hay ration.

The cost of green fodder is based on that of hay, $15.00 per ton, allowing two tons of hay, with fifteen per cent. of moisture, as the average produce of English hay per acre.

This mode of valuation has been adopted, as on previous occasions, on account of the entire absence of market prices, as far as green vetch, cow-pea and serradella are concerned. These crops, as a rule, rank higher in the scale of an agricultural valuation than the meadow grass.

Valuation per Ton of the Articles of Fodder used.

Corn meal,	$24 00	English hay,	$15 00
Corn and cob meal,	20 70	Vetch and oats,	2 75
Wheat bran,	22 50	Cow-pea,	3 14
Gluten meal,	22 50	Rowen,	15 00

The following pages contain the details of the experiment: —

FEEDING RECORD.

MAY: *Age, 7 years; Grade, Jersey; Last Calf, June 6, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.					
1888.													
July 1 to July 6, ...	–	3.25	3.25	3.25	20.00	–	–	–	26.45	11.08	2.39	1 : 6.12	905
July 10 to July 22, ...	3.25	–	3 25	3.25	5.00	62 42	–	–	29.12	11.65	2.50	1 : 5.51	890
July 26 to Aug. 1, ...	3.25	–	3.25	3.25	19.57	–	–	–	29.10	10.64	2.73	1 : 6.11	893
Aug. 11 to Aug. 25, ...	3.25	–	3.25	3.25	–	–	–	21.63	28.36	11.83	2.40	1 : 5.00	925
Sept. 7 to Sept. 14, ...	3.25	–	3.25	3.25	5.00	–	79.43	–	28.63	12.59	2.27	1 : 4.50	903
Sept. 19 to Sept. 25, ...	3.25	–	3.25	3.25	19.43	–	–	–	25.97	11.25	2.31	1 : 6.09	916

MINNIE: *Age, 8 years; Grade, Ayrshire; Last Calf, May 3, 1887.*

FEEDING PERIODS.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
July 1 to July 6, ...	–	3.25	3.25	3.25	20.00	–	–	–	26.45	11.42	2.32	1 : 6.12	1,012
July 10 to July 22, ...	3.25	–	3.25	3.25	5.00	54.39	–	–	27.23	10.92	2.19	1 : 5.43	1,005
July 26 to Aug. 1, ...	3.25	–	3.25	3.25	19.25	–	–	–	25.81	10.46	2.47	1 : 6.08	1,008
Aug. 11 to Aug. 25, ...	3.25	–	3.25	3.25	–	–	–	20.66	27.47	10.48	2.62	1 : 4.97	1,028
Sept. 7 to Sept. 14, ...	3.25	–	3.25	3.25	5.00	–	79.16	–	28.57	10.78	2.65	1 : 4.50	1,001
Sept. 19 to Sept. 25, ...	3.25	–	3.25	3.25	18.86	–	–	–	25.46	8.82	2.89	1 : 6.05	1,007

FEEDING RECORD — *Continued.*

MELIA: *Age, 10 years; Grade, Dutch; Last Calf, Aug. 5, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.					
1888.													
July 1 to July 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.45	11.79	2.24	1 : 6.12	1,016
July 10 to July 22,	3.25	–	3.25	3.25	5.00	64.33	–	–	29.81	11.62	2.57	1 : 5.53	1,044
July 26 to Aug. 1,	3.25	–	3.25	3.25	19.11	–	–	–	25.69	10.71	2.40	1 : 6.07	1,029
Aug. 11 to Aug. 25,	3.25	–	3.25	3.25	–	–	–	21.27	28.05	11.43	2.45	1 : 4.99	1,055
Sept. 7 to Sept. 14,	3.25	–	3.25	3.25	5.00	–	75.34	–	27.83	11.59	2.40	1 : 4.50	1,035
Sept. 19 to Sept. 25,	3.25	–	3.25	3.25	17.11	–	–	–	23.90	10.39	2.30	1 : 5.90	1,035

ANNIE: *Age, 5 years; Grade, Jersey; Last Calf, June 19, 1888.*

FEEDING PERIODS.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
July 1 to July 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.45	16.67	1.59	1 : 6.12	766
July 10 to July 22,	3.25	–	3.25	3.25	5.00	53.48	–	–	26.99	16.38	1.65	1 : 5.42	773
July 26 to Aug. 1,	3.25	–	3.25	3.25	16.43	–	–	–	23.30	14.36	1.71	1 : 5.84	764
Aug. 11 to Aug. 25,	3.25	–	3.25	3.25	–	–	–	19.67	26.67	14.70	1.81	1 : 4.94	763
Sept. 7 to Sept. 14,	3.25	–	3.25	3.25	5.00	–	71.00	–	26.98	15.13	1.78	1 : 4.50	774
Sept. 19 to Sept. 25,	3.25	–	3.25	3.25	17.18	–	–	–	23.97	12.64	1.90	1 : 5.91	768

FEEDING RECORD — *Concluded.*

DAISY: *Age, 5 years; Grade, Durham; Last Calf, Jan. 5, 1888.*

FEEDING PERIODS.	Feed Consumed (pounds) per day.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.					
1888.													
July 1 to July 6, . . .	–	3.25	3.25	3.25	20.00	–	–	–	26.45	14.25	1.86	1:6 12	1,084
July 10 to July 22, . . .	3.25	–	3.25	3.25	5.00	67.71	–	–	30.69	14 31	2.14	1:5.56	1,127
July 26 to Aug. 1, . . .	3.25	–	3.25	3.25	19.89	–	–	–	26.38	13.36	1.97	1:6.13	1,106
Aug. 11 to Aug. 25, . . .	3.25	–	3.25	3.25	–	–	–	21.87	28 57	13.68	2.08	1:5.01	1,113
Sept. 7 to Sept. 14, . . .	3.25	–	3.25	3.25	5.00	–	80.00	–	28.74	13.88	2.07	1:4 50	1,105
Sept. 19 to Sept. 25, . . .	3.25	–	3.25	3.25	21.00	–	–	–	27.37	9.82	2.79	1:6.22	1,084

Total Cost of Feed per Quart of Milk.

May.

Feeding Periods.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
July 1 to July 6, . . .	66.5	11.08	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	2.34
July 10 to July 22, . . .	151.1	11.65	42.25	–	42.25	42.25	65.00	811.50	–	–	3 07	2.03
July 26 to Aug. 1, . . .	74 5	10.64	22.75	–	22.75	22.75	137.00	–	–	–	1 82	2.45
Aug. 11 to Aug. 25, . . .	177.5	11.83	48.75	–	48.75	48·75	–	–	–	324.50	4 13	2.33
Sept. 7 to Sept. 14, . . .	100.8	12.59	26.00	–	26 00	26.00	40.00	–	635.75	–	2 20	2.18
Sept. 19 to Sept. 25, . . .	78.8	11.25	22.75	–	22.75	22.75	136.00	–	–	–	1 81	2.30

Minnie.

Feeding Periods.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.												
July 1 to July 6, . . .	68.50	11.42	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	2.27
July 10 to July 22, . . .	142.00	10.92	42.25	–	42 25	42.25	65.00	707.00	–	–	2 93	2.08
July 26 to Aug. 1, . . .	73.25	10.46	22.75	–	22.75	22 75	134.75	–	–	–	1 80	2.46
Aug. 11 to Aug. 25, . . .	157.25	10.48	48.75	–	48.75	48.75	–	–	–	310.00	4 02	2.56
Sept. 7 to Sept. 14, . . .	86.25	10.78	26 00	–	26.00	26.00	40.00	–	633.25	–	2 20	2.55
Sept. 19 to Sept. 25, . . .	61.75	8.82	22.75	–	22 75	22.75	132 00	–	–	–	1 78	2.88

TOTAL COST OF FEED PER QUART OF MILK — *Continued.*

Melia.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
July 1 to July 6,	70.75	11 79	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	2.20
July 10 to July 22,	151 00	11.62	42.25	–	42 25	42.25	65.00	836.25	–	–	3 11	2.05
July 26 to Aug. 1,	75.00	10.71	22.75	–	22.75	22.75	133.75	–	–	–	1 79	2.39
Aug. 11 to Aug. 25,	171 50	11.43	48 75	–	48.75	48.75	–	–	–	319.00	4 09	2.38
Sept. 7 to Sept. 14,	92 75	11 59	26.00	–	26.00	26.00	40.00	–	602.75	–	2 15	2.32
Sept. 19 to Sept. 25,	72.75	10.39	22.75	–	22.75	22.75	119.75	–	–	–	1 69	2.32

Annie.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.												
July 1 to July 6,	100.00	16.67	–	19.50	19 50	19.50	120.00	–	–	–	$1 56	1.56
July 10 to July 22,	213.00	16.38	42.25	–	42 25	42 25	65.00	695.25	–	–	2 91	1.37
July 26 to Aug. 1,	100.50	14.36	22.75	–	22.75	22.75	115 00	–	–	–	1 65	1.64
Aug. 11 to Aug. 25,	220.50	14.70	48.75	–	48.75	48.75	–	–	–	255.00	3 91	1.77
Sept. 7 to Sept. 14,	121.00	15.13	26.00	–	26 00	26.00	40.00	–	568 00	–	2 10	1.44
Sept. 19 to Sept. 25,	88.50	12.64	22 75	–	22.75	22.74	120.25	–	–	–	1 69	1.91

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

Daisy.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
July 1 to July 6, . . .	85.50	14.25	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	1.82
July 10 to July 22, . . .	186.00	14.31	42.25	–	42.25	42.25	65.00	880.25	–	–	3 17	1.65
July 26 to Aug. 1, . . .	93.50	13.36	22.75	–	22.75	22.75	139.25	–	–	–	1 83	1.96
Aug. 11 to Aug. 25, . . .	205.25	13.68	48.75	–	48.75	48.75	–	–	–	328.00	4 15	2.02
Sept. 7 to Sept. 14, . . .	111.00	13.88	26.00	–	26.00	26.00	40.00	–	640.00	–	2 21	1.99
Sept. 19 to Sept. 25, . . .	68.75	9.82	22.75	–	22.75	22.75	147.00	–	–	–	1 89	2.75

Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

[Per Cent.]

	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.
Moisture, . . .	12.78	13.69	10.87	10.59	10.78	74.02		8.84
Nitrogen, . . .	1.635	1.45	2.415	5.30	1.25	.447		1.93
Phosphoric acid, . .	.746	.688	2.88	4.41	.464	.176	.09	.364
Potassium oxide, . .	.436	.548	1.64	.551	2.085	1.475	.239	2.86
Valuation per 2,000 lbs.,	$6 67	$6 09	$12 82	$18 49	$6 45	$2 94	$2 15	$9 24

Manurial Value of Feed.

Annie.

FEEDING PERIODS.	Total cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial value of the Feed after deducting the 20 per cent. taken by the milk.	Net cost of Feed for the production of milk during period.	Net cost of Feed for the production of one quart of milk.	Weight of Animal at close of period.
1888.					Cents.	Lbs.
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	.95	770
July 10 to July 22,	2 91	2 03	1 62	1 29	.61	768
July 26 to Aug. 1,	1 65	0 80	0 64	1 01	1.00	763
Aug. 11 to Aug. 25,	3 91	2 29	1 83	2 08	.94	777
Sept. 7 to Sept. 14,	2 10	1 24	0 99	1 11	.92	766
Sept. 19 to Sept. 25,	1 69	0 82	0 66	1 03	1.16	781
Total, . . .	$13 82	$7 94	$6 35	$7 47	–	–

Daisy.

1888.						
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	1.11	1,095
July 10 to July 22,	3 17	2 31	1 85	1 33	.71	1,125
July 26 to Aug. 1,	1 83	0 88	0 70	1 13	1.21	1,108
Aug. 11 to Aug. 25,	4 15	2 44	1 95	2 20	1.07	1,112
Sept. 7 to Sept. 14,	2 21	1 31	1 05	1 16	1.05	1,090
Sept. 19 to Sept. 25,	1 89	0 91	0 73	1 16	1.69	1,100
Total, . . .	$14 81	$8 61	$6 89	$7 92	–	–

MANURIAL VALUE OF FEED — *Concluded.*

May.

FEEDING PERIODS.	Total cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial value of the Feed after deducting the 20 per cent. taken by the milk.	Net cost of Feed for the production of milk during period.	Net cost of Feed for the production of one quart of milk.	Weight of Animal at close of period.
1888.					Cents.	Lbs.
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	1.43	895
July 10 to July 22,	3 07	2 20	1 76	1 31	0 86	880
July 26 to Aug. 1,	1 82	0 88	0 70	1 12	1.50	896
Aug. 11 to Aug. 25,	4 13	2 43	1 94	2 19	1.23	916
Sept. 7 to Sept. 14,	2 20	1 30	1 04	1 16	1.15	902
Sept. 19 to Sept. 25,	1 81	0 87	0 70	1 11	1.40	931
Total, . . .	$14 59	$8 44	$6 75	$7 84	–	–

Minnie.

FEEDING PERIODS.	Total cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial value of the Feed after deducting the 20 per cent. taken by the milk.	Net cost of Feed for the production of milk during period.	Net cost of Feed for the production of one quart of milk.	Weight of Animal at close of period.
1888.						
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	1.39	1,010
July 10 to July 22,	2 93	2 05	1 64	1 29	.91	990
July 26 to Aug. 1,	1 80	0 86	0 69	1 11	1.52	1,007
Aug. 11 to Aug. 25,	4 02	2 36	1 89	2 13	1.35	1,022
Sept. 7 to Sept. 14,	2 20	1 30	1 04	1 16	1.34	992
Sept. 19 to Sept. 25,	1 78	0 85	0 68	1 10	1.78	1,035
Total, . . .	$14 29	$8 18	$6 55	$7 74	–	–

Melia.

FEEDING PERIODS.	Total cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial value of the Feed after deducting the 20 per cent. taken by the milk.	Net cost of Feed for the production of milk during period.	Net cost of Feed for the production of one quart of milk.	Weight of Animal at close of period.
1888.						
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	1.34	1,019
July 10 to July 22,	3 11	2 24	1 79	1 32	.87	1,048
July 26 to Aug. 1,	1 79	0 86	0 69	1 10	1.47	1,032
Aug. 11 to Aug. 25,	4 09	2 40	1 92	2 17	1.27	1,045
Sept. 7 to Sept. 14,	2 15	1 27	1 01	1 14	1.23	1,028
Sept. 19 to Sept. 25,	1 69	0 81	0 65	1 04	1.43	1,052
Total, . . .	$14 39	$8 34	$6 67	$7 72	–	–

ANALYSES OF MILK.

[Per Cent.]

May.

	July 3.	July 17.	July 24.	Aug. 7.	Aug. 21.	Sept. 4.	Sept. 15.	Sept. 25.
Water, . .	86.91	85.95	85.72	85.88	86.60	86.12	85.85	85.95
Solids, . .	13.09	14.05	14.28	14.12	13.40	13.88	14.15	14.05
Fat (in solids),	2.44	2.85	4.04	4.40	4.28	3.79	4.54	4.29

Minnie.

Water, . .	86.95	86.48	85.37	85.63	87.10	86.64	86.03	86.00
Solids, . .	13.05	13.52	14.63	14.37	12.90	13.36	13.97	14.00
Fat (in solids),	2.57	3.22	4.08	4.83	4.11	3.91	4.65	4.66

Melia.

Water, . .	86.90	86.63	86.92	86.94	87.73	86 82	87.56	85.98
Solids, . .	13.10	13.37	13.08	13.06	12.27	13.18	12.44	14.02
Fat (in solids),	3.73	3.42	3.61	3.65	3.42	3.37	3.04	4.30

Annie.

Water, . .	88.71	88.51	88.15	87.73	88.51	88.86	87.47	87.22
Solids, . .	11.29	11.49	11.85	12.27	11.49	11.14	12.53	12.78
Fat (in solids),	2.08	1.72	2.99	3.60	3.25	2.30	3.29	3.87

Daisy.

Water, . .	86.39	–	86.84	87.46	87.76	87.39	87.49	85.77
Solids, . .	13.61	–	13.16	12.54	12.24	12.61	12 51	14.23
Fat (in solids),	2.66	–	4.08	3.50	3.54	3.46	3.46	3.98

CORN MEAL (AVERAGE).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.78	255.60	–	–	1 : 8.95
Dry matter,	87.22	1,744.40	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	1.58	31.60	–	–	
" cellulose,	1.69	33.80	11.49	34	
" fat,	3.96	79.20	60 19	76	
" protein (nitrogenous matter),	11.15	223.00	189.55	85	
Non-nitrogenous extract matter,	81.62	1,632.40	1,534.46	94	
	100.00	2,000.00	1,795.69	–	

The analyses of corn and cob meal and of English hay are the same as used in the preceding experiment.

WHEAT BRAN (AVERAGE ANALYSIS).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.87	217.40	–	–	1 : 4.05
Dry matter,	89.13	1,782.60	–	–	
	100.00	2,000,00			
Analysis of dry matter.					
Crude ash,	7.35	147.00	–	–	
" cellulose,	10.38	207.60	41.52	20	
" fat,	5.11	102.20	81.76	80	
" protein (nitrogenous matter),	16.96	339.20	298.50	88	
Non-nitrogenous extract matter,	60.20	1,204.00	963.20	80	
	100.00	2,000.00	1,384.98	–	

GLUTEN MEAL (AVERAGE).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10 59	211.80	–	–	1 : 2.01
Dry matter,	89.41	1,788.20	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	.53	10.60	–	–	
" cellulose,	.89	17.80	6.05	34	
" fat,	5.49	109.80	83.45	76	
" protein (nitrogenous matter),	37.04	740.80	629.68	85	
Non-nitrogenous extract matter,	56 05	1,121.00	1,053.74	94	
	100.00	2,000.00	1,772.92	–	

VETCH AND OATS.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	74.02	1,480.40	–	–	–
Dry matter,	25.98	519.60	–	–	–
	100.00	2,000.00	–	–	–
Analysis of dry matter.					
Crude ash,	7.39	147.80	–	–	–
" cellulose,	35.81	716.20	–	–	–
" fat,	2.29	45.80	–	–	–
" protein (nitrogenous matter),	10.76	215.20	–	–	–
Non-nitrogenous extract matter,	43.75	875.00	–	–	–
	100.00	2,000.00	–	–	–

Cow-Pea.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	80.45	1,609.00	–	–	1 : 4.44
Dry matter,	19.55	391.00	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	7.44	148.80	–	–	
" cellulose,	25.88	517.60	243.27	47	
" fat,	2.62	52.40	30.92	59	
" protein (nitrogenous matter),	17.93	358.60	215.16	60	
Non-nitrogenous extract matter,	46.13	922.60	636.59	69	
	100.00	2,000.00	1,125.94	–	

Rowen.

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.84	176.80	–	–	1 : 6.4
Dry matter,	91.16	1,823.20	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	10.50	210.00	–	–	
" cellulose,	29.46	589.20	341.74	58	
" fat,	3.05	61.00	28.06	46	
" protein (nitrogenous matter),	13.20	264.00	150.48	57	
Non-nitrogenous extract matter,	43.79	875.80	551.75	63	
	100.00	2,000.00	1,072.03	–	

Experiment Station Farm.

Milk and Creamery Record from Nov. 1, 1887, to Oct. 31, 1888.

	Quarts of Milk produced.	Spaces of Cream from Milk.	Price allowed per Space.	Amount received from Creamery.
1887.				
Nov. 1 to Nov. 30, .	1,692½	756	3.75 cents.	$28 35
Dec. 1 to Dec. 31, .	1,667	872	3.875 "	33 79
1888.				
Jan. 1 to Jan 31, .	1,979¼	1,105	4.00 "	44 20
Feb. 1 to Feb. 29, .	2,108¾	1,067	4.00 "	42 68
March 1 to March 31, .	1,965	1,013	3.90 "	39 50
April 1 to April 30, .	1,864¼	951	3.65 "	34 71
May 1 to May 31, .	1,798¾	941	3.50 "	32 94
June 1 to June 30, .	1,701½	848	3.25 "	27 56
July 1 to July 31, .	1,966½	920	3.25 "	29 90
Aug. 1 to Aug. 31, .	1,858	894	3.50 "	31 29
Sept. 1 to Sept. 30, .	1,730¼	822	3.75 "	30 82
Oct. 1 to Oct. 31, .	1,759½	897	3.85 "	34 53
Total, ...	22,091¼	11,086	–	$410 27

1887.

Nov., 6.62 spaces of cream make 1 pound of butter, equal to 24.85 cents per pound.

Dec., 6.69 spaces of cream make 1 pound of butter, equal to 25.94 cents per pound.

1888.

Jan., 6.63 spaces of cream make 1 pound of butter, equal to 25.54 cents per pound.

Feb., 6.60 spaces of cream make 1 pound of butter, equal to 26.40 cents per pound.

March, 6.60 spaces of cream make 1 pound of butter, equal to 25.74 cents per pound.

April, 6.65 spaces of cream make 1 pound of butter, equal to 24.27 cents per pound.

May, 6.46 spaces of cream make 1 pound of butter, equal to 22.58 cents per pound.

June, 6.35 spaces of cream make 1 pound of butter, equal to 20.63 cents per pound.

July, 6.45 spaces of cream make 1 pound of butter, equal to 20.96 cents per pound.

Aug., 6.34 spaces of cream make 1 pound of butter, equal to 22.19 cents per pound.

Sept., 6.45 spaces of cream make 1 pound of butter, equal to 24.32 cents per pound.

Oct., 6.39 spaces of cream make 1 pound of butter, equal to 24.61 cents per pound.

III. Feeding Experiments with Pigs: Skim Milk, Corn Meal, Corn and Cob Meal, Wheat Bran and Gluten Meal.

Our annual report for 1887 contains a description of seven successive feeding experiments with growing pigs, which were instituted mainly for the purpose of ascertaining the cost of the feed required for the production of a definite weight of dressed pork.

In the first and second cases, creamery buttermilk and home-made skim milk with corn meal had furnished the sole ingredients of the daily diet of the animals on trial; whilst, during the five succeeding ones, wheat bran and gluten meal had been added as fodder constituents. (For details, see Fifth Annual Report, pages 55 to 83.)

In comparing the final results of the different experiments from a financial stand-point, adopting in all cases, for obvious reasons, a corresponding local market value of the fodder articles used, it was found that feeding skim milk or creamery buttermilk and corn meal in connection with wheat bran and gluten meal, as described in the Fifth Annual Report, experiments III., IV., V., VI., VII., had lessened the net cost of production of dressed pork.

This reduction appeared, however, to be due in the majority of experiments (III., IV., V. and VI.,) rather to a higher commercial value of the manurial refuse resulting, than to a higher nutritive effect of the stated change in the character of the diet. The results obtained in the seventh experiment alone furnished an exception to this circumstance; for, in this case, the smallest quantity of the total weight of the dry feed consumed showed not only a high commercial value of the manurial refuse resulting, but also the highest nutritive effect. The subsequent reprinted summary of the seven experiments may serve as a further illustration of the previous discussion.

Summary of Experiments.

[Based on the same cost of feed and manurial valuation of feed consumed.]

EXPERIMENTS.	Average amount of Dry Matter for production of one pound of Dressed Pork (in lbs.).	Cost of Feed per pound of Dressed Pork (in cents).	Manurial Value of Feed per pound of Dressed Pork (in cents).	Net Cost of Feed per pound of Dressed Pork after deducting thirty per cent. from Manurial Value (in cents).
II.,	3.31	5.51	2.30	3.90
III., IV., V.,	3.86	5.92	2.91	3.88
VI.,	3.56	5.69	2.78	3.74
VII.,	3.07	5.15	2.52	3.39

From the above summary it is apparent that the course of feeding adopted in the seventh experiment has given the most satisfactory pecuniary results; for the net cost of feed consumed amounted to 3.39 cents per pound of dressed pork produced, after allowing a loss of thirty per cent. of the manurial value of the feed, in consequence of the growth of the animal. As we sold our dressed pork for from 5½ to 7½ cents per pound, we received from 1.5 to 3.5 cents for labor, housing, etc.

The statement that an addition of gluten meal or of wheat bran or of both, to a diet which previously consisted only of skim milk and corn meal, tends to increase the commercial value of the manurial refuse resulting, is based on the following considerations: —

First. The principal fertilizing elements contained in a mixture of equal parts of gluten meal and wheat bran have a higher market value than those contained in an equal weight of corn meal.

Second. It is admissible, for mere practical purposes, to assume that, in raising one and the same kind of animals to a corresponding weight, a corresponding amount of nitrogen, of phosphoric acid, of potash, etc., will be retained and stored up in the growing animal.

An excess, therefore, of any or of all of the three essential fertilizing constituents previously specified, in one diet, as compared with that of another one, counts in favor of that

particular diet, as far as net cost of feed is concerned. Although it must be acknowledged that, even in one and the same feeding experiment, most likely no two animals would show strictly corresponding relations in that direction, it remains not less true that it is a most commendable practice, in a general farm management, to consider carefully the relative value of the fertilizing constituents contained in the various fodder articles which present themselves for our choice in the compounding of suitable fodder rations. Our allowance of a loss of thirty per cent. of the essential fertilizing constituents contained in the food consumed, in consequence of the development and growth of the animal, is purposely a liberal one. The adoption of this basis for our estimate tends to strengthen our conclusion that the raising of pigs for the home market can be made a profitable branch of farm industry, even with comparatively limited resources.

It has been stated that, during our III., IV., V., VI. and VII. experiments, the same fodder articles, skim milk, corn meal, wheat bran and gluten meal, had been used to compound the daily diet; and that the seventh feeding experiment had yielded the highest profits on the same basis of selling price. As the daily fodder rations thus in all of these trials had consisted of the same kind of fodder ingredients, and as at all periods of the experiments the call for food had been attended to with care, it became evident that the particular mode of combining at different times the same fodder ingredients to make up the daily diet had to be considered the principal cause of the difference in our results.

To test the correctness of this conclusion it was decided to constitute a new experiment. The same mode of compounding the daily fodder ration for different periods of growth, which had been adopted during the seventh experiment, was to be carried out with a new lot of pigs. (See experiments VIII. and IX. further on.)

The following short abstract, taken from a more detailed description of the seventh feeding experiment in our last annual report, cannot fail to assist in a desirable understanding of the question involved: —

Seven animals, crosses between White Chester and Black Berkshire, served in this experiment (VII.). Their live

weights were from twenty-two to twenty-six pounds in case of different animals. The same fodder articles were used as in the third, fourth, fifth and sixth experiments; they were, however, fed in different proportions. The daily ration of corn meal was gradually increased during the progress of the experiment, for the purpose of altering the relative proportion between the nitrogenous and non-nitrogenous matter in the feed. The relative proportion of one part of digestible nitrogenous matter to two and nine-tenths parts of digestible non-nitrogenous matter was changed at stated periods until it reached 1 : 4.28; practically, three feeding periods.

AVERAGE OF DAILY RATIONS (EXPERIMENT VII.).

	Corn Meal (Ounces).	Skim Milk (Quarts).	Wheat Bran (Ounces).	Gluten Meal (Ounces).	Feeding Periods.	Nutritive Ratio of Food.
June 28 to July 11,	8.00	4	–	–	I.	1:2.91
July 12 to July 25,	12.00	6	–	–		
July 26 to July 28,	12.00	6	1 34	2.66	II.	1:2.85
July 29 to Aug. 8,	12.00	6	2.00	4.00		
Aug. 9 to Aug. 15,	14 67	6	2.66	2.66	III.	1:3.34
Aug. 16 to Aug. 23,	17.34	6	5.33	5.33		
Aug. 24 to Aug. 29,	20 00	6	8.00	8.00		
Aug. 30 to Sept. 12,	23.34	6	11.35	11.35		
Sept. 13 to Sept. 26,	29.00	6	17.00	17.00		
Sept. 27 to Oct. 11,	47.00	6	12.00	12.00	IV.	1: 4.28
Oct. 12 to Oct. 27.	62.66	6	15.66	15.66		

SUMMARY OF EXPERIMENT VII.

MARK OF PIG.	Corn Meal (in lbs.).	Skim Milk (in gals.).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Live Weight gained during Experiment (in lbs.).	Dressed Weight gained during Experiment (in lbs.).	Cost per pound of Dressed Pork (cents).
N, . . .	202.93	176.0	60.04	61.66	163.75	129.36	5.39
O, . . .	203.09	176.0	60.21	61.83	161.00	127.19	5.49
P, . . .	203.00	176.0	60.21	61.83	174.00	139.20	5.02
Q, . . .	194.09	173.0	57.71	59.93	164.50	128.31	5.27
R, . . .	194.43	173.0	58.04	59.66	177.50	138.45	4.89
S, . . .	194.43	173.0	58.04	59.66	162.50	128.38	5.26
T, . . .	194.43	173.0	58.04	59.66	178.25	140.85	4.80
	1,386.40	1,220.0	412.29	424.23	1,181.50	931.74	–

Total Cost of Feed consumed during the Above-stated Experiment (1887).

1,386.40 lbs. corn meal, at $24.00 per ton, ...	$16 64
1,220.00 gals. skim milk, at 1.8 cents per gallon, . . .	21 96
412.29 lbs. wheat bran, at $22.50 per ton, ...	4 64
424.23 lbs. gluten meal, at $22.50 per ton, ...	5 77
	$48 01

Average cost of feed for production of one pound of dressed pork, 5.15 cents.

Manurial Value of Feed consumed during the Above Experiment.

Corn Meal.	Skim Milk.	Wheat Bran.	Gluten Meal.	Total.
$5 52	$11 32	$2 97	$3 71	$23 52

Manurial value of feed for production of one pound of dressed pork, 2.52 cents.

The cost of feed consumed varied, in case of different animals, from 4.80 to 5.49 cents per pound of dressed pork produced.

Taking the entire lot of animals into consideration, it amounts to 5.15 cents per pound of dressed pork obtained. The amount of dry matter contained in the feed required for the production of one pound of dressed pork varied from 2.83 to 3.24 pounds.

Basis of Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used (1887).

	Per Cent.			
	Corn Meal.	Skim Milk.	Wheat Bran.	Gluten Meal.
Moisture,	10.00	90.00	10.80	8.80
Nitrogen (17 cents per lb.),	1.96	0.55	2.80	5.03
Phosphoric acid (6 cents per lb.),	0.77	0.17	2.36	0.30
Potassium oxide (4½ cents per lb.),	0.45	0.20	1.36	0.03
Valuation per 2,000 lbs.,	$7.97	$2.25	$13.51	$17.49

Eighth Feeding Experiment.

Six animals of a mixed breed, weighing from twenty-three to twenty-nine pounds, served in the experiment. The latter began Nov. 8, 1887, and lasted until March 12, 1888, or 124 days; the average of the individual live weight had reached 185 pounds. Skim milk, corn meal or corn and cob meal, wheat bran and gluten meal, furnished the fodder ingredients of the daily diet. The corn and cob meal took the place of the clear corn meal on the 8th of January. The daily ration of skim milk reached, within the first week, six quarts per head. This amount, being the limit of our home supply, was fed daily until the close of the experiment. Skim milk and corn meal, two ounces of the latter to one quart of the former, constituted the diet for about three weeks, when the steadily increasing demand for food was supplied by a gradually increasing quantity of a mixture consisting of two weight parts of gluten meal and one weight part of wheat bran. On the 3d of January, at the beginning of the third month, the daily diet was changed; the latter consisted thereafter of six quarts of skim milk and a mixture prepared of four weight parts of corn and cob meal, one weight part of wheat bran, and one weight part of gluten meal. The quantity required of the latter to meet the daily wants of the animals began with forty-eight ounces per head, and rose gradually to seventy-two ounces. (See, for details, subsequent tabular statement.)

AVERAGE OF DAILY RATIONS (EXPERIMENT VIII.).

	Corn Meal (ounces).	Skim Milk (quarts).	Wheat Bran (ounces).	Gluten Meal (ounces).	Corn and Cob Meal (ounces).	Feeding Periods.	Nutritive Ratio of Food.
1887.							
Nov. 8 to Nov. 15, . .	10	5	-	-	-	I.	1:2.92
Nov. 16 to Nov. 29, . .	12	6	-	-	-		
Nov. 30 to Dec. 13, . .	12	6	2.38	4.76	-	II.	1:2.30
Dec. 14 to Dec. 20, . .	12	6	5.35	11.06	-		
1888.							
Dec. 21 to Jan. 3, . .	12	6	9.43	18.86	-		
Jan. 4 to Jan. 7, . .	32	6	8.00	8.00	-	III.	1:3.80
Jan. 8 to Jan. 16, . .	-	6	8.87	8.87	35.48		
Jan. 17 to Jan. 30, . .	-	6	9.81	9.81	39.24		
Jan. 31 to Feb. 20, . .	-	6	8.00	8.00	48.00	IV.	1:4.17
Feb. 21 to March 11, . .	-	6	8.81	8.81	52.86		

The entire experiment was managed, as far as practicable, to serve as a repetition of our seventh feeding experiment. The substitution of the corn and cob meal of our own production from a superior home-raised corn, for the clear corn meal of our general market, may well be considered of but little consequence. This view is fully supported by a careful analysis of both.

The financial results of the eighth experiment, like those of the seventh, are superior to those obtained in the preceding five feeding experiments. This fact becomes still more worthy of notice when considering that the seventh experiment was carried on during a warmer period of the year, and thus under more favorable circumstances than the eighth experiment. Our late results seem to confirm the conclusions arrived at in our previous experiments, namely: —

First. A gradual periodical change, from a rich nitrogenous diet to that of a wider ratio between the digestible nitrogenous and non-nitrogenous food constituents of the feed, is recommendable in the interest of good economy.

Second. The feeding effect of one and the same diet changes with the advancing growth of the animal on trial.

Third. The power of assimilating food and of converting it into live weight decreases with the progress in age.

Fourth. It is not good economy to raise pigs for the meat market to an exceptionally high weight. To go beyond from 175 to 180 pounds is only advisable when exceptionally high market prices for dressed pork can be secured.

In addition to what has been said on this particular point in previous communications, I insert here, in a tabular form, the estimated cost of feed used for the production of one pound of live weight during the succeeding stages of growth of the entire lot of pigs which served in the eighth experiment.

Cost of Feed for the Production of One Pound of Live Weight during the Different Feeding Periods.

	Live weight of animals at close of feeding period (in lbs.).	Gain in live weight during period (in lbs.).	One hundred lbs. of dry matter in feed produced live weight (in lbs.).	Cost of feed for production of one lb. of live weight (in cts.).
U. I. Feeding period,	48.50	22.50	63.4	3.24
II. " "	96.50	48.00	51.2	3.58
III. " "	134.00	37.50	33.2	4.80
IV. " "	189.00	55.00	27.3	5.40
V. I. Feeding period,	43.00	20.00	56.3	3.65
II. " "	91.00	48.00	51.2	3.58
III. " "	132.00	41.00	35.8	4.44
IV. " "	198.00	66.00	32.8	4.50
W. I. Feeding period,	44.00	21.50	60.5	3.40
II. " "	96.00	52.00	55.5	3.31
III. " "	130.00	34.00	30.1	5.29
IV. " "	187.00	57.00	28.3	5.21
X. I. Feeding period,	46.00	21.00	59.1	3.48
II. " "	93.00	47.00	50.1	3.66
III. " "	128.00	35.00	30.6	5.20
IV. " "	178.50	50.50	25.0	5.88
Y. I. Feeding period,	46.00	21.00	59.1	3.48
II. " "	93.50	47.50	50.7	3.62
III. " "	133.00	39.50	34.5	4.61
IV. " "	181.50	48.50	23.8	6.12
Z. I. Feeding period,	52.00	22.50	63.4	3.24
II. " "	97.00	45.00	48.0	3.82
III. " "	132.50	35.50	31.1	5.13
IV. " "	184.50	52.00	25.8	5.71

[U.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	–	–	–	1 : 2.92	26.00	48.50	1 1
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	–	1 : 2.30	48.50	96.50	1 6
Jan. 4 to Jan. 30,	162.00	9.00	16.00	16.00	55.00	1 : 3.80	96.50	134 00	1 5
Jan. 31 to Mar. 12,	246.00	–	21.27	21.27	127.59	1 : 4.17	134.00	189.00	1 5

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter,	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter,	43.69 "
49.68 lbs. wheat bran, equal to dry matter,	44.15 "
62.10 lbs. gluten meal, equal to dry matter,	56.03 "
182.59 lbs. corn and cob meal, equal to dry matter,	157.59 "
Total amount of dry matter,	434.84 lbs.

Live weight of animal at beginning of experiment,	26.00 lbs.
Live weight at time of killing,	189.00 "
Live weight gained during experiment,	163.00 "
Dressed weight at time of killing,	154.00 "
Loss in weight by dressing,	35 lbs., or 18.52 per cent.
Dressed weight gained during experiment,	132.82 lbs.

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon,	$3.33
50.26 lbs. corn meal, at $23.00 per ton,	.58
49.68 lbs. wheat bran, at $23.00 per ton,	.57
62.10 lbs. gluten meal, at $27.00 per ton,	.84
182.59 lbs. corn and cob meal, at $20.70 per ton,	1.90
	$7.22

2.69 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.28 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.44 cents.

PERIOD I.	Cost of feed consumed during period, . .	$0.73
	22.50 lbs. live weight gained; cost per lb., .	3.24 cts.
	18.33 lbs. dressed weight gained; cost per lb., .	3.98 cts.
PERIOD II.	Cost of feed consumed during period, . .	$1.72
	48.00 lbs. live weight gained; cost per lb., .	3.58 cts.
	39.11 lbs. dressed weight gained; cost per lb., .	4 40 cts.
PERIOD III.	Cost of feed consumed during period, . .	$1.80
	37.50 lbs. live weight gained; cost per lb., .	4.80 cts.
	30.55 lbs. dressed weight gained; cost per lb., .	5.89 cts.
PERIOD IV.	Cost of feed consumed during period, . .	$2.97
	55.00 lbs. live weight gained; cost per lb., .	5.40 cts.
	44.81 lbs. dressed weight gained; cost per lb., .	6.63 cts.

[V.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	–	–	–	1 : 2.92	23.00	43.00	0 15
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	–	1 : 2.30	43.00	91.00	1 6
Jan. 4 to Jan. 30,	162.00	9.00	16.17	16.17	55.68	1 : 3.80	91.00	132.00	1 7
Jan. 31 to Mar. 12,	246.00	–	21.27	21.27	127.59	1 : 4.17	132.00	198.00	1 10

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter, ...	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter, ...	43.69 "
49 85 lbs. wheat bran, equal to dry matter, . . .	44.30 "
62.27 lbs. gluten meal, equal to dry matter, . . .	56.19 "
183.27 lbs. corn and cob meal, equal to dry matter, . .	158.18 "
Total amount of dry matter, ...	435.74 lbs.

Live weight at beginning of experiment, ...	23.00 lbs.
Live weight at time of killing, ...	198.00 "
Live weight gained during experiment, ...	175.00 "
Dressed weight at time of killing, ...	160.00 "
Loss in weight by dressing, . . .	38 lbs., or 19.19 per cent.
Dressed weight gained during experiment, . . .	141.41 lbs.

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon, ...	$3.33
50.26 lbs. corn meal at $23.00 per ton, ...	.58
49.85 lbs. wheat bran, at $23.00 per ton, ...	.57
62.27 lbs. gluten meal, at $27.00 per ton, ...	.84
183.27 lbs. corn and cob meal, at $20.70 per ton, . . .	1.91
	$7.23

2.49 lbs. dry matter yielded 1 lb. of live weight, and 3.08 lbs. dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. dressed pork, 5.11 cents.

PERIOD I.	Cost of feed consumed during period, . .	$0.73
	20.00 lbs. live weight gained; cost per lb., . .	3.65 cts.
	16.16 lbs. dressed weight gained; cost per lb., .	4.52 cts.
PERIOD II.	Cost of feed consumed during period, . .	$1.72
	48.00 lbs. live weight gained; cost per lb., . .	3.58 cts.
	38.79 lbs. dressed weight gained; cost per lb., .	4.43 cts.
PERIOD III.	Cost of feed consumed during period, . .	$1.82
	41.00 lbs. live weight gained; cost per lb., . .	4.44 cts.
	33.13 lbs. dressed weight gained; cost per lb., .	5.49 cts.
PERIOD IV.	Cost of feed consumed during period, . .	$2.97
	66.00 lbs. live weight gained; cost per lb., . .	4.50 cts.
	53.33 lbs. dressed weight gained; cost per lb., .	5.57 cts.

[W.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	–	–	–	1:2.92	22.50	44.00	1 0
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	–	1:2.30	44.00	96.00	1 8
Jan. 4 to Jan. 30,	162.00	9.00	16.00	16.00	55.00	1:3.80	96 00	130.00	1 2
Jan. 31 to Mar. 12,	246.00	–	21.27	21.27	127.59	1:4.17	130.00	187.00	1 6

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter, ...	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter, ...	43.69 "
49.68 lbs. wheat bran, equal to dry matter, . . .	44.15 "
62.10 lbs. gluten meal, equal to dry matter, . . .	56.03 "
182.59 lbs. corn and cob meal, equal to dry matter, . .	157.59 "
Total amount of dry matter, ...	434.84 lbs.

Live weight of animal at beginning of experiment, . .	22.50 lbs.
Live weight at time of killing, ...	187.00 "
Live weight gained during experiment, ...	164.50 "
Dressed weight at time of killing, ...	151.00 "
Loss in weight by dressing, ...	36 lbs., or 19.25 per cent.
Dressed weight gained during experiment, . . .	132.83 "

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon, ...	$3.33
50.26 lbs. corn meal, at $23.00 per ton, ...	.58
49.68 lbs. wheat bran, at $23.00 per ton, ...	.57
62.10 lbs. gluten meal at $27.00 per ton, ...	.84
182.59 lbs. corn and cob meal at $20.70 per ton, . . .	1.90
	$7.22

2.64 lbs. dry matter yielded 1 lb. live weight, and 3.27 lbs. dry matter yielded 1 lb. dressed weight.

Cost of feed for production of 1 lb. dressed pork, 5.44 cents.

PERIOD I.	Cost of feed consumed during period, . .	$0.73
	21.50 lbs. live weight gained; cost per lb., . .	3.40 cts.
	17.36 lbs. dressed weight gained; cost per lb., .	4.20 cts.
PERIOD II.	Cost of feed consumed during period, . .	$1.72
	52.00 lbs. live weight gained; cost per lb., . .	3.31 cts.
	41.99 lbs. dressed weight gained; cost per lb., .	4.10 cts.
PERIOD III.	Cost of feed consumed during period, . .	$1.80
	34.00 lbs. live weight gained; cost per lb., . .	5.29 cts.
	27.45 lbs. dressed weight gained; cost per lb., .	6.56 cts.
PERIOD IV.	Cost of feed consumed during period, . .	$2.97
	57.00 lbs. live weight gained; cost per lb., . .	5.21 cts.
	46.03 lbs. dressed weight gained; cost per lb., .	6.45 cts.

[X.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	–	–	–	1:2.92	25.00	46.00	0 15
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	–	1:2.30	46.00	93 00	1 5
Jan. 4 to Jan. 30,	162.00	9 00	16.17	16.17	55.68	1:3.81	93.00	128.00	1 3
Jan. 31 to Mar. 12,	246.00	–	21.27	21.27	127.59	1:4.17	128.00	178.50	1 3

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter,	133.38 lbs.
50 26 lbs. corn meal, equal to dry matter,	43.69 "
49.85 lbs. wheat bran, equal to dry matter,	44.30 "
62.27 lbs. gluten meal, equal to dry matter,	56.19 "
183.27 lbs. corn and cob meal, equal to dry matter,	158.18 "
	435.74 lbs.

Live weight of animal at beginning of experiment,	25.00 lbs.
Live weight at time of killing,	178.50 "
Live weight gained during experiment,	153.50 "
Dressed weight at time of killing,	160.00 "
Loss in weight by dressing,	18.50 lbs., or 10.38 per cent.
Dressed weight gained during experiment,	137.59 lbs.

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon,	$3.33
50.26 lbs. corn meal, at $23.00 a ton,	.58
49.85 lbs. wheat bran, at $23.00 per ton,	.57
62.27 lbs. gluten meal, at $27.00 per ton,	.84
183.27 lbs. corn and cob meal, at $20.70 per ton,	1.91
	$7.23

2.84 lbs. of dry matter yielded 1 lb. of live weight, and 3.17 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.33 cts.

PERIOD I.	Cost of feed consumed during period,	$0.73
	21.00 lbs. live weight gained; cost per lb.,	3.48 cts.
	18.82 lbs. dressed weight gained; cost per lb.,	3.88 cts.
PERIOD II.	Cost of feed consumed during period,	$1.72
	47.00 lbs. live weight gained; cost per lb.,	3.66 cts.
	42.12 lbs. dressed weight gained; cost per lb.,	4.08 cts.
PERIOD III.	Cost of feed consumed during period,	$1.82
	35.00 lbs. live weight gained; cost per lb.,	5.20 cts.
	31.37 lbs. dressed weight gained; cost per lb.,	5.80 cts.
PERIOD IV.	Cost of feed consumed during period,	$2.97
	50.50 lbs. live weight gained; cost per lb.,	5.88 cts.
	45.26 lbs. dressed weight gained; cost per lb.,	6.56 cts.

[Y.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	-	-	-	1:2.92	25.00	46.00	0 15
Nov. 30 to Jan. 3,	210.00	25 88	12.41	24.83	-	1:2.30	46.00	93.50	1 5
Jan. 4 to Jan. 30,	162.00	9.00	16.17	16.17	55.68	1:3.81	93.50	133.00	1 6
Jan. 31 to Mar. 12,	246.00	-	21.27	21.27	127.59	1:4.17	133.00	181.50	1 2

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter, ...	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter, ...	43.69 "
49.85 lbs. wheat bran, equal to dry matter, . . .	44.30 "
62.27 lbs. gluten meal, equal to dry matter, . . .	56.19 "
183.27 lbs. corn and cob meal, equal to dry matter, . .	158.18 "
Total amount of dry matter, ...	435.74 lbs.

Live weight of animal at beginning of experiment, . .	25.00 lbs.
Live weight at time of killing, ...	181.50 "
Live weight gained during experiment, ...	156.50 "
Dressed weight at time of killing, ...	150.00 "
Loss in weight by dressing, . . .	31.00 lbs., or 17.08 per cent.
Dressed weight gained during experiment, . . .	129.27 lbs

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon, ...	$3 33
50.26 lbs. corn meal at $23.00 per ton, ...	.58
49.85 lbs. wheat bran, at $23.00 per ton, ...	.57
62.27 lbs. gluten meal at $27.00 per ton, ...	.84
183.27 lbs. corn and cob meal, at $20.70 per ton, . . .	1.91
	$7.23

2.78 lbs. of dry matter yielded 1 lb. of live weight, and 3.37 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.59 cents.

PERIOD I.	Cost of feed consumed during period,	$0.73
	21.00 lbs. live weight gained; cost per lb.,	3.48 cts.
	17.83 lbs. dressed weight gained; cost per lb.,	4.09 cts.
PERIOD II.	Cost of feed consumed during period,	$1.72
	47.50 lbs. live weight gained; cost per lb.,	3.62 cts.
	39.39 lbs. dressed weight gained; cost per lb.,	4.37 cts.
PERIOD III.	Cost of feed consumed during period,	$1.82
	39.50 lbs. live weight gained; cost per lb.,	4.61 cts.
	32.75 lbs. dressed weight gained; cost per lb.,	5.56 cts.
PERIOD IV.	Cost of feed consumed during period,	$2.97
	48.50 lbs. live weight gained; cost per lb.,	6.12 cts.
	40.22 lbs. dressed weight gained; cost per lb.,	7.38 cts.

[Z.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	–	–	–	1:2.92	29.50	52.00	1 0
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	–	1:2.30	52.00	97.00	1 5
Jan. 4 to Jan. 30,	162.00	9.00	16.17	16.17	55.68	1:3.81	97.00	132.50	1 4
Jan. 31 to Mar. 12,	246.00	–	21.27	21.27	127.59	1:4.17	132.50	184.50	1 4

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter,	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter,	43.69 "
49.85 lbs. wheat bran, equal to dry matter,	44.30 "
62.27 lbs. gluten meal, equal to dry matter,	56.19 "
183.27 lbs. corn and cob meal, equal to dry matter,	158.18 "
Total amount of dry matter,	435.74 lbs.

Live weight of animal at beginning of experiment,	29.50 lbs.
Live weight at time of killing,	184.50 "
Live weight gained during experiment,	155.00 "
Dressed weight at time of killing,	150.00 "
Loss in weight by dressing,	34.50 lbs., or 18.70 per cent.
Dressed weight gained during experiment,	126.02 lbs.

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon,	$3.33
50.26 lbs. corn meal, at $23.00 per ton,	.58
49.85 lbs. wheat bran, at $23.00 per ton,	.57
62.27 lbs. gluten meal, at $27.00 per ton,	.84
183.27 lbs. corn and cob meal, at $20.70 per ton,	1.91
	$7.23

2.81 lbs. of dry matter yielded 1 lb. live weight, and 3.46 lbs. of dry matter yielded 1 lb. dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.74 cts.

PERIOD I.	Cost of food consumed during period,	$0.73
	22.50 lbs. live weight gained; cost per lb.,	3.24 cts.
	18.29 lbs. dressed weight gained; cost per lb.,	3.99 cts.
PERIOD II.	Cost of feed consumed during period,	$1.72
	45.00 lbs. live weight gained; cost per lb.,	3.82 cts.
	36.58 lbs. dressed weight gained; cost per lb.,	4.70 cts.
PERIOD III.	Cost of feed consumed during period,	$1.82
	35.50 lbs. live weight gained; cost per lb.,	5.13 cts.
	28.86 lbs. dressed weight gained; cost per lb.,	6.31 cts.
PERIOD IV.	Cost of feed consumed during period,	$2.97
	52.00 lbs. live weight gained; cost per lb.,	5.71 cts.
	42.28 lbs. dressed weight gained; cost per lb.,	7.02 cts.

SUMMARY OF EXPERIMENT VIII.

	Corn Meal (in lbs.).	Skim Milk (in gals.).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Corn and Cob Meal (in lbs.).	Live weight gained during experiment (in lbs.).	Dressed weight gained during experiment (in lbs.).	Cost per lb. of Dressed Pork (cts.).
U,	50.26	185 25	49.68	62.10	182.59	163.00	132.82	5.44
V,	50.26	185.25	49.85	62.27	183.27	175.00	141.41	5.11
W,	50.26	185.25	49.68	62.10	182.59	164.50	132.83	5.44
X,	50.26	185.25	49.85	62.27	183.27	153.50	137.59	5.33
Y,	50 26	185.25	49.85	62.27	183.27	156.50	129.27	5.59
Z,	50.26	185.25	49.85	62.27	183.27	155.00	126.02	5.74
Total,	301.56	1,111.50	298.76	373.28	1,098.26	967.50	799.94	–

Total Cost of Feed consumed during Experiment.

1111.50 gals. skim milk, at 1.8 cents per gallon,	$20.01
301.56 lbs. corn meal, at $23 00 per ton,	3.47
298.76 lbs. wheat bran, at $23.00 per ton,	3.44
373.28 lbs. gluten meal at $27.00 per ton,	5.04
1098.26 lbs. corn and cob meal, at $20.70 per ton,	11.42
	$43.38

Average cost of feed for production of 1 lb. dressed pork, 5.42 cts.

Manurial Value of Feed consumed during Experiment.

Skim milk,	$8.85
Corn meal,	1.09
Wheat bran,	1.99
Gluten meal,	2.88
Corn and cob meal,	3.33
	$18.14

Manurial value of feed for production of 1 lb. of dressed pork, 2.27 cts.

Basis of Valuation of Essential Fertilizing Constituents in the Various Articles of Fodder used (1888).

	Per Cent.				
	Corn Meal.	Skim Milk.	Wheat Bran.	Gluten Meal.	Corn and Cob Meal.
Moisture,	13.08	91.00	11.14	9.77	13.69
Nitrogen ($16\frac{1}{2}$ cents per lb.),	1.80	.47	2.78	4.57	1.45
Phosphoric acid (6 cents per lb.),	.74	.22	1.86	.30	.69
Potassium oxide ($4\frac{1}{4}$ cents per lb.),	.43	.21	1.07	.03	.55
Valuation per 2,000 lbs.,	$7.20	$1.99	$12.35	$15.46	$6.06

The net cost of feed consumed for the production of one pound of dressed pork, making a deduction of thirty per cent. of the fertilizing constituents contained in the feed, varies in the case of different animals from 3.52 cents to 4.00 cents per pound. In the case of the entire lot of pigs, it amounts to 3.83 cents per pound. As we sold our dressed pork at $7\frac{3}{4}$ cents per pound, we secured 3.92 cents per pound sold for investment, labor and profit.

It will be noticed that our estimates above are based on the ruling local market prices of the time when our late experiments were carried on. These prices differ from those adopted on earlier occasions. An intelligent comparison of our late financial results with those obtained in previous experiments can only be made by using corresponding values. The subsequent page contains a re-valuation of our late results, on the basis of market value used in all previous feeding experiments.

SUMMARY OF EXPERIMENT BASED ON THE SAME COST OF FEED AND OF MANURIAL VALUE OF FEED CONSUMED AS USED IN PRECEDING EXPERIMENTS.

Total Cost of Feed consumed during Experiment.

1111.50 gals. skim milk, at 1.8 cents per gallon,	$20.01
301.56 lbs. corn meal, at $24.00 per ton,	3.62
298.76 lbs. wheat bran, at $22.50 per ton,	3.36
373.28 lbs. gluten meal, at $22.50 per ton,	4.20
1098.26 lbs. corn and cob meal, at $20.70 per ton,	11.42
	$42.61

Average cost of feed for production of 1 lb. dressed pork, 5.32 cts.

Manurial Value of Feed consumed during Experiment.

Skim milk,	$10.00
Corn meal,	1.20
Wheat bran,	2.02
Gluten meal,	3.26
Corn and cob meal,	3.33
	$19.81

Manurial value of feed for production of 1 lb. dressed pork, 2.48 cts.

The net cost of feed for the production of one pound of dressed pork, taking the entire lot of pigs into consideration, amounts to 3.69 cents. This result is the second best in our whole series of experiments. This fact becomes more significant when it is duly considered that the experiment (VIII.) was carried out during the winter season. The task of maintaining a desirable moderate temperature in the piggery during the entire trial becomes more difficult in winter than during any other season of the year. Low temperature requires more food for the support of respiration; the normal condition of the animal system is apt to be more seriously affected in various directions, and the gain in live weight suffers usually correspondingly in case of the same diet.

To confirm, if possible, our previously advanced conclusions still more, it was decided to repeat our mode of feeding with another lot of pigs during the latter part of spring and the summer season. An examination of our ninth experiment, which is described in a few subsequent pages, cannot fail to show that they are fully sustained.

Analyses of Fodder Articles used in Experiment VIII.

Skim Milk (Average).

	Per Cent.
Moisture at 100° C.,	91.00
Dry matter,	9.00
	100.00

Analysis of Dry Matter.

Crude ash,	6.67
" fat,	2.78
" protein (nitrogenous matter),	34.00
Non-nitrogenous extract matter,	56.55
	100.00

Nutritive ratio, 1 : 1.86.

Corn Meal (Average).

	Percentage composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.08	261.60	–	–	1 : 9.66
Dry matter,	86.92	1,738.40	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	1.66	33.20	–	–	
" cellulose,	3.49	69.80	23.73	34	
" fat,	4.97	99.40	75.54	76	
" protein (nitrogenous matter),	10.39	207.80	176.63	85	
Non-nitrogenous extract matter,	79.49	1,589.80	1,494.41	94	
	100.00	2,000.00	1,770.41		

WHEAT BRAN (AVERAGE).

	Percentage composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.14	222.80	–	–	1 : 3.85
Dry matter,	88.86	1,777.20	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	6.59	131.80	–	–	
" cellulose,	12.80	256.00	51.20	20	
" fat,	6.00	120.00	96.00	80	
" protein (nitrogenous matter),	17.72	354.40	311.87	88	
Non-nitrogenous extract matter,	56.89	1,137.80	910.24	80	
	100.00	2,000.00	1,369.31	–	

GLUTEN MEAL (AVERAGE).

	Percentage composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.77	195.40	–	–	1 : 2.11
Dry matter,	90.23	1,804.60	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	.93	18.60	–	–	
" cellulose,	4.60	92.00	31.28	34	
" fat,	6.63	132.60	100.78	76	
" protein (nitrogenous matter),	35.43	708.60	602.31	85	
Non-nitrogenous extract matter,	52.41	1,048.20	985.31	94	
	100.00	2,000.00	1,719.68	–	

Corn and Cob Meal.

	Per cent.
Moisture at 100° C.,	13.69
Dry matter,	86.31
	100.00

Analysis of Dry Matter.

Crude ash,	1.68
" cellulose,	7.75
" fat,	3.67
" protein (nitrogenous matter),	9.13
Non-nitrogenous extract matter,	77.77
	100.00

Nutritive ratio, 1 : 8.8.

Ninth Experiment.

Six pigs of a mixed breed, weighing from seventeen to twenty-two pounds each, served in the experiment. The feeding began April 12, and closed August 8. The live weights of the animals at the time of killing varied from 185 to 203.5 pounds. Skim milk, corn meal, gluten meal and wheat bran furnished the ingredients of the diet. The mode of feeding was practically divided into three periods, with reference to the nutritive character of the feed, as follows: —

	Live Weight of Animal.	Nutritive Ratio.
I. Period,	20 to 90 lbs.,	1 digestible nitrogenous; 2.66 digestible non-nitrogenous constituents.
II. Period,	90 to 130 lbs.,	1 digestible nitrogenous; 3.62 digestible non-nitrogenous constituents.
III. Period,	130 to 200 lbs.,	1 digestible nitrogenous; 4.35 digestible non-nitrogenous constituents.

AVERAGE OF DAILY RATIONS (EXPERIMENT IX.).

	Corn Meal (ounces).	Skim Milk (quarts).	Wheat Bran (ounces).	Gluten Meal (ounces).	Corn and Cob Meal (ounces).	Feeding Periods.	Nutritive Ratio of Food.
1888.							
April 12 to April 23, . .	–	3	–	–	6.	I.	1 : 2.80
April 24 to May 1, . .	–	6	–	–	12.		
May 2 to May 14, . .	–	6	3.47	6.94	12.	II.	1 : 2.53
May 15 to May 28, . .	–	6	9.89	19.78	12.		
May 29 to June 4, . .	–	6	10.67	21.34	12.		
June 5 to June 22, . .	–	6	8.65	8.65	34.60	III.	1 : 3.63
June 23 to July 3, . .	–	6	9.86	9.86	39.44		
July 4 to July 9, . .	–	6	7.70	7.70	46.20	IV.	1 : 4.35
July 10 to July 25, . .	56.10	6	9.35	9.35	–		
July 26 to Aug. 8, . .	63.00	6	10.50	10.50	–		

[1.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	–	83.00	10.38	–	–	1 : 2.80	21.50	50.00	1 7
May 2 to June 4,	–	204.00	25.50	15.60	31.21	1 : 2.53	50.00	95.00	1 5
June 5 to July 3,	–	174.00	66.12	16.87	17.99	1 : 3.62	95.00	140.25	1 10
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	140.25	200.75	1 11

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter, . . .	95.03 lbs.
675.00 qts. skim milk, equal to dry matter, . . .	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter, . .	102.44 "
53.65 lbs. wheat bran, equal to dry matter, . . .	46.94 "
70.38 lbs. gluten meal, equal to dry matter, . . .	63.28 "
Total amount of dry matter, ...	429.19 lbs.

Live weight of animal at beginning of experiment,	21.50 lbs.
Live weight of animal at time of killing,	200.75 "
Live weight gained during experiment,	179.25 "
Dressed weight at time of killing,	162.00 "
Loss in weight by dressing,	38.75 lbs., or 19.3 per cent.
Dressed weight gained during experiment,	144.65 lbs.

Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23.00 per ton,	$1 26
268.75 gals. skim milk, at 1.8 cents per gallon,	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton,	1 23
53.65 lbs. wheat bran, at $23.00 per ton,	62
70.38 lbs. gluten meal, at $27.00 per ton,	84
	$6 99

2.40 lbs. of dry matter fed yielded 1 lb. of live weight, and 2.97 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 4.83 cents.

[2.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	-	83.00	10.38	-	-	1 : 2.80	20.00	45.00	1 4
May 2 to June 4,	-	204.00	25.50	15.60	31.21	1 : 2.53	45.00	88.00	1 5
June 5 to July 3,	-	174.00	65.09	16.60	16.93	1 : 3.63	88.00	128.25	1 6
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	128.25	185.75	1 95

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter,	95.03 lbs.
675.00 qts. skim milk, equal to dry matter,	121.50 "
117.66 lbs. corn and cob meal, equal to dry matter,	101.55 "
53.38 lbs. wheat bran, equal to dry matter,	46.71 "
69.32 lbs. gluten meal, equal to dry matter,	62.33 "
Total amount of dry matter,	427.12 lbs.

Live weight of animal at beginning of experiment,	20.00 lbs.
Live weight of animal at time of killing,	185.75 "
Live weight gained during experiment,	165.75 "
Dressed weight at time of killing,	152.00 "
Loss in weight by dressing,	33.75 lbs., or 18.17 per cent.
Dressed weight gained during experiment,	135.63 lbs.

Cost of Feed consumed during Experiment.

189.97 lbs. corn meal, at $23.00 per ton,	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon,	3 04
117.66 lbs. corn and cob meal, at $20.70 per ton,	1 22
53.38 lbs. wheat bran, at $23.00 per ton,	61
69.32 lbs. gluten meal, at $24.00 per ton,	83
	$6 96

2.58 lbs. dry matter fed yielded 1 lb. of live weight, and 3.17 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.13 cents.

[3.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	–	83.00	10.38	–	–	1 : 2.80	19.00	44.50	1 4
May 2 to June 4,	–	204.00	25.50	15.60	31.21	1 : 2.53	44.50	91.25	1 6
June 5 to July 3,	–	174.00	66.12	16.87	17.99	1 : 3.62	91.25	132.00	1 6
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	132.00	196.25	1 11.5

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter,	95.03 lbs.
675.00 qts. skim milk, equal to dry matter,	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter,	102.44 "
53.65 lbs. wheat bran, equal to dry matter,	46.94 "
70.38 lbs. gluten meal, equal to dry matter,	63.28 "
Total amount of dry matter,	429.19 lbs.

Live weight of animal at beginning of experiment,	19.00 lbs.
Live weight of animal at time of killing,	196.25 "
Live weight gained during experiment,	177.25 "
Dressed weight at time of killing,	159.00 "
Loss in weight by dressing,	37.25 lbs., or 18.98 per cent.
Dressed weight gained during experiment,	143.61 lbs.

Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23.00 per ton,	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon,	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton,	1 23
53.65 lbs. wheat bran, at $23.00 per ton,	62
70.38 lbs. gluten meal, at $24.00 per ton,	84
	$6 99

2.42 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.00 lbs of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 4.86 cents.

[4.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	–	83.00	10.38	–	–	1 : 2.80	17.00	42.00	1 4
May 2 to June 4,	–	204.00	25.50	15.60	31.21	1 : 2.53	42.00	85.25	1 4
June 5 to July 3,	–	174.00	66.12	16.87	17.99	1 : 3.62	85.25	126.00	1 6
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	126.00	188.75	1 12

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter,	95.03 lbs.
675.00 qts. skim milk, equal to dry matter,	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter,	102 44 "
53.65 lbs. wheat bran, equal to dry matter,	46.94 "
70.38 lbs. gluten meal, equal to dry matter,	63.28 "
Total amount of dry matter,	429.19 lbs.

Live weight of animal at beginning of experiment,	17.00 lbs.
Live weight of animal at time of killing,	188.75 "
Live weight gained during experiment,	171.75 "
Dressed weight at time of killing,	154.25 "
Loss in weight by dressing,	34.50 lbs., or 18.27 per cent.
Dressed weight gained during experiment,	140.36 lbs.

Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23 00 per ton,	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon,	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton,	1 23
53.65 lbs. wheat bran, at $23.00 per ton,	62
70.38 lbs. gluten meal, at $24.00 per ton,	84
	$6 99

2.50 lbs. dry matter fed yielded 1 lb. of live weight, and 3.06 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 4.98 cents.

[5.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	-	83.00	10.38	-	-	1 : 2.80	21.50	45.00	1 3
May 2 to June 4,	-	204.00	25.50	15.60	31.21	1 : 2.53	45.00	86.75	1 4
June 5 to July 3,	-	174.00	66.12	16.87	17.99	1 : 3.62	86.75	129.50	1 7.5
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	129.50	193.75	1 12

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter,	95.03 lbs.
675.00 qts. skim milk, equal to dry matter,	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter,	102.44 "
53.65 lbs. wheat bran, equal to dry matter,	46.96 "
70.38 lbs. gluten meal, equal to dry matter,	63.28 "
Total amount of dry matter,	429.19 lbs.

Live weight of animal at beginning of experiment,	21.50 lbs.
Live weight of animal at time of killing,	193.75 "
Live weight gained during experiment,	172.25 "
Dressed weight at time of killing,	158.00 "
Loss in weight by dressing,	35.75 lbs., or 18.45 per cent.
Dressed weight gained during experiment,	140.47 lbs.

Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23.00 per ton,	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon,	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton,	1 23
53.65 lbs. wheat bran, at $23.00 per ton,	62
70.38 lbs. gluten meal, at $24.00 per ton,	84
	$6 99

2.49 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.07 lbs. of dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 4.97 cents.

[6.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.)	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.)	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	–	83.00	10.38	–	–	1 : 2.80	18.25	47.00	1 7
May 2 to June 4,	–	204.00	25.50	15.60	31.21	1 : 2.53	47.00	95.00	1 7
June 5 to July 3,	–	174.00	66.12	16.87	17.99	1 : 3.62	95.00	142.25	1 10
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	142.25	203.50	1 11

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter,	95.03 lbs.
675.00 qts. skim milk, equal to dry matter,	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter,	102.44 "
53.65 lbs. wheat bran, equal to dry matter,	46.94 "
70.38 lbs. gluten meal, equal to dry matter,	63.28 "
Total amount of dry matter,	429.19 lbs.

Live weight of animal at beginning of experiment,	18.25 lbs.
Live weight of animal at time of killing,	203.50 "
Live weight gained during experiment,	185.25 "
Dressed weight at time of killing,	165.50 "
Loss in weight by dressing,	35 lbs., or 17.2 per cent.
Dressed weight gained during experiment,	153.39 lbs.

Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23.00 per ton,	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon,	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton,	1 23
53.65 lbs. wheat bran, at $23.00 per ton,	62
70.38 lbs. gluten meal, at $24.00 per ton,	84
	$6 99

2.32 lbs. of dry matter fed yielded 1 lb. of live weight, and 2.81 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 4.56 cents.

SUMMARY OF EXPERIMENT IX.

	Corn Meal (in lbs.).	Skim Milk (in gals.).	Corn and Cob Meal (in lbs.).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Live Weight gained during experiment (in lbs.).	Dressed Weight gained during experiment (in lbs.).	Cost per pound of Dressed Pork (cents).
1,	109.97	168.75	118.69	53.65	70.38	179.25	144.65	4.83
2,	109.97	168.75	117.66	53.38	69.32	165.75	135.63	5.13
3,	109.97	168.75	118.69	53.65	70.38	177.25	143.61	4.86
4,	109.97	168.75	118.69	53.65	70.38	171.75	140.36	4.98
5,	109.97	168.75	118.69	53.65	70.38	172.25	140.47	4.97
6,	109.97	168.75	118.69	53.65	70.38	185.25	153.39	4.56
	659.82	1,012.50	711.11	321.63	421.22	1,051.50	858.11	-

Total Cost of Feed consumed during the Above-stated Experiment.

659.82 lbs. corn meal, at $23.00 per ton,	$7 59
1,012.50 gals. skim milk, at 1.8 cents per gallon,	18 23
711.11 lbs. corn and cob meal, at $20.70 per ton,	7 36
321.63 lbs. wheat bran, at $23.00 per ton,	3 70
421.22 lbs. gluten meal, at $24.00 per ton,	5 05
	$41 93

Average cost of feed for production of 1 lb. of dressed pork, 5.15 cents.

Manurial Value of Feed consumed during the Above Experiment.

Corn Meal.	Skim Milk.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Total.
$2 11	$8 29	$2 16	$2 01	$4 05	$18 62

Manurial value of feed for production of 1 lb. of dressed pork, 2.17 cents.

SUMMARY OF EXPERIMENTS (II. TO IX. INCLUSIVE).

[Based on the same cost of feed and manurial valuation of feed consumed.]

EXPERIMENTS.	Average amount of Dry Matter for production of one pound of Dressed Pork (in lbs.).	Cost of Feed per pound of Dressed Pork (in cents).	Manurial Value of Feed per pound of Dressed Pork (in cents).	Net Cost of Feed per pound of Dressed Pork after deducting thirty per cent. from Manurial Value (in cents).
II.,	3.31	5.51	2.30	3.90
III., IV., V.,	3.86	5.92	2.91	3.88
VI.,	3.56	5.69	2.78	3.74
VII.,	3.07	5.15	2.52	3.39
VIII.,	3.27	5.32	2.48	3.58
IX.,	3.00	4.89	2.30	3.27

Cost of Feed for the Production of One Pound of Live Weight during the Different Feeding Periods.

	Live Weight of Animal at close of feeding period (in lbs.).	Gain in Live Weight during period (in lbs.).	Cost of Feed for production of one pound of Live Weight (in cents).
1. I. Feeding Period,	50.00	28.50	1.72
II. " "	95.00	45.00	3.87
III. " "	140.25	45.25	4.13
IV. " "	200.75	60.50	4.78
2. I. Feeding Period,	45.00	25.00	1.96
II. " "	88.00	43.00	4.05
III. " "	128.25	40.25	4.57
IV. " "	185.75	57.50	5.03
3. I. Feeding Period,	44.50	25.50	1.92
II. " "	91.25	46.75	3.72
III. " "	132.00	40.75	4.59
IV. " "	196.25	64.25	4.50
4. I. Feeding Period,	42.00	25.00	1.96
II. " "	85.25	43.25	4.02
III. " "	126.00	40.75	4.59
IV. " "	188.75	62.75	4.61
5. I. Feeding Period,	45.00	23.50	2.09
II. " "	86.75	41.75	4.17
III. " "	129.50	42.75	4.38
IV. " "	193.75	64.25	4.50
6. I. Feeding Period,	47.00	28.75	1.70
II. " "	95.00	48.00	3.63
III. " "	142.25	47.25	3.96
IV. " "	203.50	61.25	4.72

Analyses of Fodder Articles used in Experiment IX.

CORN MEAL.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.59	271.80	–	–	1 : 9.56
Dry matter,	86.41	1,728.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.68	33.60	–	–	
" cellulose,	1.56	31.20	10.61	34	
" fat,	3.10	62.00	47.12	76	
" protein (nitrogenous matter),	10.42	208.40	177.14	85	
Non-nitrogenous extract matter,	83.24	1,664.80	1,564.91	94	
	100.00	2,000.00	1,799.78	–	

The analyses of corn and cob meal and of skim milk are the same as used in the preceding experiment.

WHEAT BRAN.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.50	250.00	–	–	1 : 3.86
Dry matter,	87.50	1,750.00	–	–	
	100.00	2,000.00			
Analysis of Dry Matter.					
Crude ash,	6.80	136.00	–	–	
" cellulose,	10.70	214.00	42.80	20	
" fat,	5.49	109.80	87.84	80	
" protein (nitrogenous matter),	17.79	355.80	313.10	88	
Non-nitrogenous extract matter,	59.22	1,184.40	947.52	80	
	100.00	2,000.00	1,391.26	–	

GLUTEN MEAL.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.09	201.80	–	–	1 : 1.82
Dry matter,	89.91	1,798.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.51	10.20	–	–	
" cellulose,	.86	17.20	5.85	34	
" fat,	4.86	97.20	73.87	76	
" protein (nitrogenous matter),	39.28	785.60	667.76	85	
Non-nitrogenous extract matter,	54.49	1,089.80	1,024.41	94	
	100.00	2,000.00	1,771.89	–	

Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents; potassium oxide, 4¼ cents.

	PER CENT.				
	Corn Meal.	Skim Milk.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.
Moisture,	13.59	–	13.69	12.50	10.09
Nitrogen,	1.60	.48	1.45	2.49	5.65
Phosphoric acid,	.662	.22	.688	2.54	.455
Potassium oxide,	.387	.21	.548	1.45	.059
Valuation per 2,000 lbs.,	$6 40	$2 02	$6 09	$12 50	$19 25

ANALYSES OF FODDER ARTICLES.

Corn Fodder (Pride of the North).

	Per cent.
Moisture at 100° C.,	24.87
Dry matter,	75.13
	100.00

Analysis of Dry Matter.

Crude ash,	5.14
" cellulose,	22.26
" fat,	2.62
" protein (nitrogenous matter),	8.28
Non-nitrogenous extract matter,	61.70
	100.00

Fertilizing Constituents in Corn Fodder.

Moisture at 100° C.,	24.87
Nitrogen (16½ cts. per lb.),	.995
Phosphoric acid (6 cts. per lb.),	.201
Calcium oxide,	.310
Magnesium oxide,	.093
Potassium oxide (4¼ cts. per lb.),	1.465
Sodium oxide,	.794
Ferric oxide,	.026
Insoluble matter,	1.318
Valuation per 2,000 lbs.,	$4 77

Weight of stalk and ear (average),	8 oz.
" stalk (average),	3 oz.
" ear (average),	5 oz.

The above material was cut when the kernels began to glaze. Part of the crop was put into a silo. Both products have been used of late in our feeding experiments with milch cows.

Corn Cob (Pride of the North).

[Experiment Station, 1887.]

	Per cent.
Moisture at 100° C.,	24.76
Dry matter,	75.24
	100.00

Analysis of Dry Matter.

	Per cent.
Crude ash,	1.75
" cellulose,	33.77
" fat,	.53
" protein (nitrogenous matter),	3.00
Non-nitrogenous extract matter,	60.95
	100.00

Fertilizing Constituents in Corn Cob.

Moisture at 100° C.,	24.76
Nitrogen (16½ cts. per lb.),	.36
Phosphoric acid (6 cts. per lb.),	.069
Calcium oxide,	.005
Magnesium oxide,	.008
Potassium oxide (4¼ cts. per lb.),	.512
Sodium oxide,	.265
Ferric oxide,	.006
Insoluble matter,	.267
Valuation per 2,000 lbs.,	$1 71

CORN AND COB MEAL (PRIDE OF THE NORTH).

[Experiment Station, 1887.]

	PER CENT.	
	I.	II.
Passed sieve, 144 meshes to square inch,	75.36	73 85
Moisture at 100° C.,	26.34	13.69
Dry matter,	73.66	86.31
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	1.64	1.68
" cellulose,	6.31	7.75
" fat,	3.36	3.67
" protein (nitrogenous matter),	7.82	9.13
Non-nitrogenous extract matter,	80.87	77.77
	100.00	100.00

Fertilizing Constituents in Corn and Cob Meal.

	Per cent.
Moisture at 100° C.,	26.34
Nitrogen (16½ cts. per lb.),	1.24
Phosphoric acid (6 cts. per lb.),	.587
Calcium oxide,	.095
Magnesium oxide,	.131
Potassium oxide (4¼ cts. per lb.),	.468
Sodium oxide,	.200
Ferric oxide,	.004
Insoluble matter,	.130
Valuation per 2,000 lbs.,	$5 19

Corn Ensilage.

[Sent on from Marblehead, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	78.88	83.48
Dry matter,	21.12	16.52
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	6.32	4.30
" cellulose,	25.77	35.25
" fat,	3.27	3.33
" protein (nitrogenous matter),	8.94	6.91
Non-nitrogenous extract matter,	55.70	50.21
	100.00	100.00

Both samples of ensilage, it is stated, were planted and harvested at the same time; both had their kernels fully developed, just past the milky state, when they were put into a silo, Sept. 20 to 30, 1887. No. I. is from "Stowell's Evergreen Sweet," and No. II. from common "Southern White" corn.

Ensilage No. I. shows a larger percentage of nitrogenous and non-nitrogenous matter than No. II., yet it was of a decidedly inferior general state of preservation when received at our office. Whether this circumstance applies to the entire contents of each silo, or is merely of an accidental nature, we are unable to decide.

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.97	239.40	–	–	
Dry matter,	88.03	1,760.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.48	29.60	–	–	1 : 8.41
" cellulose,	1.83	36.60	12.44	34	
" fat,	4.81	96.20	73.11	76	
" protein (nitrogenous matter),	11.88	237.60	201.96	85	
Non-nitrogenous extract matter,	80.00	1,600.00	1,504.00	94	
	100.00	2,000.00	1,791.51	–	

Wheat Bran.

[Sent on from North Amherst, Mass.]

68.97 per cent. passed screen 144 mesh to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.43	188.60	–	–	
Dry matter,	90.57	1,811.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.27	125.40	–	–	1 : 4.00
" cellulose,	12.98	259.60	51.92	20	
" fat,	4.36	87.20	69.76	80	
" protein (nitrogenous matter),	16.76	335.20	294.98	88	
Non-nitrogenous extract matter,	59.63	1,192.60	954.08	80	
	100.00	2,000.00	1,370.74	–	

The material is of a fair average composition.

Fertilizing Constituents in Wheat Bran.

	Per cent.
Moisture at 100° C.,	9.43
Phosphoric acid (6 cts. per lb.),	2.67
Magnesium oxide,	.83
Calcium oxide,	.18
Potassium oxide (4¼ cts. per lb.),	1.51
Sodium oxide,	.15
Nitrogen (16½ cts. per lb.),	2.43
Insoluble matter,	.24
Valuation per 2,000 lbs.,	$12 50

WHEAT BRAN.
[Amherst Mill.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.25	185.00	–	–	
Dry matter,	90.75	1,815.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.90	158.00	–	–	
" cellulose,	10.05	201.00	40.20	20	1 : 4.26
" fat,	4.73	94.60	75.68	80	
" protein (nitrogenous matter),	16.12	322.40	283.71	88	
Non-nitrogenous extract matter,	61.20	1,224.00	979.20	80	
	100.00	2,000.00	1,378.79	–	

Wheat Bran.

[Amherst Mills.]

67.50 per cent. passed screen 144 mesh to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.89	197.80	–	–	1 : 3.57
Dry matter,	90.11	1,802.22	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.26	145.20	–	–	
" cellulose,	14.80	296.00	59.20	20	
" fat,	5.22	104.40	83.52	80	
" protein (nitrogenous matter),	18.17	363.40	319.79	88	
Non-nitrogenous extract matter,	54.55	1,091.00	872.80	80	
	100.00	2,000.00	1,335.31	–	

Gluten Meal.

[Bought at Springfield, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.50	190.00	–	–	1 : 1.95
Dry matter,	90.50	1,810.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.08	21.60	–	–	
" cellulose,	4.74	94.80	32.23	34	
" fat,	3.92	78.40	59.58	76	
" protein (nitrogenous matter),	36.19	723.80	615.23	85	
Non-nitrogenous extract matter,	54.07	1,081.40	1,016.52	94	
	100.00	2,000.00	1,723.56	–	

Gluten Meal.

[Bought at Springfield, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.10	222.00	–	–	
Dry matter,	88.90	1,778.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.55	11.00	–	–	
" cellulose,	.91	18.20	6.19	34	1 : 2.24
" fat,	6.13	122.60	93.18	76	
" protein (nitrogenous matter),	34.79	695.80	591.43	85	
Non-nitrogenous extract matter,	57.62	1,152.40	1,083.26	94	
	100.00	2,000.00	1,774.06	–	

Rowen.

[Grown at the Experiment Station, 1887. Contained a liberal admixture of clover.]

	Per cent.
Moisture at 100° C.,	8.84
Dry matter,	91.16
	100.00

Analysis of Dry Matter.

Crude ash,	10.50
" cellulose,	29.46
" fat,	3.05
" protein (nitrogenous matter),	13.20
Non-nitrogenous extract matter,	13.79
	100.00

Fertilizing Constituents of the above Rowen.

Moisture at 100° C.,	8.840
Nitrogen (16½ cts. per lb.),	1.930
Phosphoric acid (6 cts. per lb.),	.364
Potassium oxide (4¼ cts. per lb.),	2.860
Calcium oxide,	.853
Magnesium oxide,	.197
Sodium oxide,	.122
Ferric oxide,	.057
Insoluble matter,	2.178
Valuation per 2,000 lbs.,	$9 24

Provender.

[From Amherst Mill.]

	Per cent.
Moisture at 100° C.,	9.40
Dry matter,	90.60
	100.00

Analysis of Dry Matter.

Crude ash,	3.42
" cellulose,	11.52
" fat,	5.76
" protein (nitrogenous matter),	14.35
Non-nitrogenous extract matter,	64.95
	100.00

Nutritive ratio, 1 : 7.56.

This article is, according to statement, a mixture of 450 pounds of corn, 125 pounds of oats, and 100 pounds of wheat bran.

Ground Oat Feed.

[Sent on from Salem, Mass.]

	Per cent.
Moisture at 100° C.,	8.92
Dry matter,	91.08
	100.00

Analysis of Dry Matter.

Crude ash,	3.52
" cellulose,	8.78
" fat,	8.34
" protein (nitrogenous matter),	18.66
Non-nitrogenous extract matter,	60.69
	100.00

The article is evidently a compound containing admixtures which are richer in nitrogenous matter and fat than oats. A mere analysis of a compound commercial fodder article is only of interest to the practical farmer when the amount and kind of ingredients which serve in its preparation are well known. It is not safe, as a rule, to invest to any extent in a compound commercial fodder article without feeling well satisfied concerning the character of its various ingredients.

Spent Brewer's Grain.

72.63 per cent. passed through mesh 144 to square inch.

	Per cent.
Moisture at 100° C.,	6.98
Dry matter,	93.02
	100.00

Analysis of Dry Matter.

Crude ash,	6.15
" cellulose,	15.90
" fat,	1.95
" protein (nitrogenous matter),	20.49
Non-nitrogenous extract matter,	55.51
	100.00

Fertilizing Constituents of Spent Brewer's Grain.

Moisture at 100° C.,	6.98
Nitrogen (16½ cts. per lb.),	3.05
Phosphoric acid (6 cts. per lb.),	1.26
Potassium oxide (4¼ cts. per lb.),	1.552
Calcium oxide,	.296
Magnesium oxide,	.286
Sodium oxide,	.347
Ferric oxide,	.159
Insoluble matter,	1.770
Valuation per 2,000 lbs.,	$12 88

The material is of a fair quality as far as composition is concerned.

Cotton Hulls.

[I. and II. sent on from Boston, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.17	11.45
Dry matter,	89.83	88.85
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	2.75	3.38
" cellulose,	51.40	40.24
" fat,	2.36	4.27
" protein (nitrogenous matter),	4.90	5.36
Non-nitrogenous extract matter,	38.59	46.75
	100.00	100.00

Fertilizing Constituents of Cotton Hulls.

[I. and II. sent on from Boston (same as above); III. sent on from Memphis, Tenn.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	10.17	11.45	8.76
Phosphoric acid,	.14	.28	.18
Magnesium oxide,	.23	.29	.25
Calcium oxide,	.13	.20	.22
Potassium oxide,	1.12	1.06	1.07
Nitrogen,	.77	.76	.74
Insoluble matter,	.06	.003	.11
Valuation per 2,000 lbs.,	$3 66	$3 75	$3 57

Cotton-seed Meal.

[Sent on from North Amherst, Mass.]

68.34 per cent. passed sieve 144 mesh to square inch.

	Per cent.
Moisture at 100° C.,	6.84
Dry matter,	93.16
	100.00

Analysis of Dry Matter.

Crude ash,	7.06
" cellulose,	10.83
" fat,	13.02
" protein (nitrogenous matter),	40.13
Non-nitrogenous extract matter,	28.96
	100.00

A fair sample of its kind.

FIELD EXPERIMENTS.

I. Field A. Fodder Corn raised with Single Articles of Plant Food.

II. Field B. Fodder Crops raised with and without Complete Manure.

III. Field C. Experiments with Fodder Crops for Green Fodder.

IV. Experiments with Potatoes; and Paper on Potato Scab, by Prof. James E. Humphrey.

V. Experiments with Root Crops.

VI. Notes on Miscellaneous Field Work.

FIELD EXPERIMENTS.

[Field A.]

I. Fodder Corn raised upon Worn-out Meadow Lands partly fertilized with One or Two Special Articles of Plant Food, partly without the Use of any Manurial Matter.

The observations recorded below extend already over a period of five years.* The field selected for the experiment was utilized for a series of years previous to 1882 as a meadow for the production of hay. The annual yield of that crop had suffered at that time a serious decline in quantity and quality. During the spring of 1883 it was planted with corn for the production of fodder corn, without the use of any manurial matter.

The same course of planting and of general treatment was carried out during the year 1884. The corn fodder raised in that year left no doubt about the serious exhaustion of the soil, as far as its fitness for a further successful cultivation of corn fodder was concerned, for the entire yield of that crop amounted only to 5,040 pounds per acre, with a moisture of thirty per cent. The soil had evidently reached a condition which promised to prove favorable for a special investigation, as far as the extent and the particular character of its exhaustion on plant food was concerned, whether the failure of the crop was due to a general exhaustion of

* For details, see preceding reports, 1883, 1884, 1885, 1886, 1887.

essential articles of plant food, or to that of any particular one of them.

As the cultivation of grasses and fodder corn affects the manurial resources of the soil in a similar direction, by abstracting approximately one part of phosphoric acid to four parts of potash, it seemed but natural that a soil which originally did not contain much more of available potash than of available phosphoric acid must become unproductive, as far as these crops are concerned, before the latter is exhausted. It is not less evident that a system of manuring, devised with reference to this circumstance alone, can prevent an early decline of remunerative crops in the majority of cases.

The recognized importance of both — grasses and fodder corn — in our present system of general farm management has served as the principal inducement to begin our field experiments at the Experiment Station with a practical illustration of the particular serious changes which a close rotation of these crops produces in the existing soil resources of plant food, wherever the adopted system of manuring does not provide for a periodical return of fertilizing substances, with reference to the kind and to the amount of each of them carried off by the crop.

The land set apart for the experiment consists of ten adjoining plats, one-tenth of an acre each in size. The plats are five feet apart; the grounds between them are kept free from any growth, and receive no fertilizing ingredients of any description. The entire field is surrounded by a tile drain, and each plat has a separate one through its centre. This terminates at its east end in a well, which is connected with the surrounding drain.

The systematic treatment of the various plats began in May, 1885. All were ploughed, year after year, at the same time and in the same manner, — in autumn after harvesting and in spring before manuring and planting Plats 1, 3, 5, 7, 9 and 10 received annually for three succeeding years, 1885, 1886 and 1887, an addition of a definite amount of either phosphoric acid or of a nitrogen compound or of a potash compound; while plats 2, 4, 6 and 8 received no

manurial matter during that period. All, except plat 6, were planted during the above-stated three succeeding years with the same variety of corn (Clark). Plat 6 received during that time no fertilizing material; it was ploughed and worked with the cultivator in the same manner and at the same time when the other plats were thus treated; it was kept clear, as far as practicable, from every kind of vegetable growth (black fallow).

The details of the work and of the annual results of the course pursued in the management of the experiment have been described in the preceding annual report. The subsequent summary may suffice here to record the principal facts brought out before the beginning of the present year (1888).

FIELD "A."

[1882, a meadow; 1883, planted with "Longfellow" corn; 1884, 1885, 1886 and 1887, planted with "Clark" corn.]

Number of Plat.	Fertilizers Applied.			Yield of Dry Fodder Corn.		
	1885.	1886.	1887.	1885.	1886.	1887.
				Lbs.	Lbs.	Lbs.
Plat 1, .	25 lbs. sodium nitrate (= 4 lbs. nitrogen).	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen).	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen), and 50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	480	430	720
Plat 2, .	Nothing, ...	Nothing, ...	Nothing, ...	310	250	165
Plat 3, .	30 lbs. dried blood (= 4 lbs. nitrogen).	60 lbs. dried blood (= 7 to 8 lbs. nitrogen).	60 lbs. dried blood (= 7 to 8 lbs. nitrogen), 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), ...	350	310	240
Plat 4, .	Nothing, ...	Nothing, ...	Nothing, ...	300	250	130
Plat 5, .	25 lbs. ammonium sulphate (= 5 lbs. nitrogen).	50 lbs. ammonium sulphate (= 10 lbs. nitrogen).	50 lbs. ammonium sulphate (= 10 lbs. nitrogen), and 97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), ...	360	280	635
Plat 6, .	Fallow, ...	Fallow, ...	Fallow, ...	-	-	-
Plat 7, .	50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), and 50 lbs. muriate of potash (= 25 lbs. potassium oxide), . .	280	255	730
Plat 8, .	Nothing, ...	Nothing, ...	Nothing, ...	250	195	165
Plat 9, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	945	840	655
Plat 10, .	48½ lbs. of potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen), ...	845	895	940

A careful study of these results shows that neither phosphoric acid nor any form of nitrogen, when applied each by itself, even in exceptionally large proportions, has produced a material change in the annual yield, as compared with that obtained on unfertilized plats. The application of potash compounds alone shows in every instance a decided increase in the crop. The annual yield was increased by its use during the first two years to twice the amount of that previous to its special application.

1888. — The original plan of the experiment has not been altered materially during the past season. The principal aim of our investigation has been the same as during the three preceding years; namely, to study the direction and the degree of exhaustion on plant food of field "A" during the progress of our investigation.

The results of the past season (1888) confirm the conclusion presented in our previous annual report, 1887. An exceptional deficiency of the soil on available potash, produced by continued close rotation of grasses and corn fodder, without any substantial provision for an exceptionally large consumption of potash, proves still the first cause of a reduced annual yield of corn fodder.

The exhaustion on available plant food assumes, however, as might be expected, a more general character as years pass on. This fact shows itself plainly in a gradual falling off of the annual yield on plat 9, where a liberal amount of potash as the sole fertilizing material exerted in preceding years a marked beneficial influence on the annual yield. The same circumstance causes evidently the lower yield upon those plats (1 and 7) which received a liberal manuring with potash compounds two years later, and, after a repeated application of each, phosphoric acid or nitrogen had failed to improve the annual yield.

A manuring for three successive years with potash alone has sufficed in our case to terminate its beneficial effect on the natural productiveness of the soil, as far as the corn crop is concerned. More complete manures are required to restore a desirable degree of fertility of the soil.

The result obtained on plat 6 deserves a particular notice. This plat had been used, in common with the entire area

occupied by our experiment, for two years in succession, — 1883 and 1884, — for the production of fodder corn without the use of any manurial matter. The degree of exhaustion of the entire field was very marked and practically uniform. During the spring of 1885, when all other plats were planted with the same variety of corn, plat 6 was ploughed and harrowed like the remainder, but not planted with corn; it was assigned to the task of ascertaining the effects of "black fallow" on the soil under treatment. It seemed of interest, in connection with our inquiry, to illustrate the influence of mere atmospheric agencies on the future productiveness of our field. For this purpose, during the years 1885, 1886 and 1887, the plat was ploughed, harrowed and treated with the cultivator in the same manner and at the same time as the remaining plats. During that entire period no manurial matter of any description was applied. The appearance of every description of vegetation was, as far as practicable, prevented by a timely use of the cultivator.

At the beginning of the past season, after having produced no crop for three succeeding years, it was prepared in the same way and at the same time as the other plats for the planting of one and the same variety of corn. No manurial matter was on that occasion applied to plat 6. The date of planting the corn, and the subsequent treatment of the crop to the time of harvesting, was the same in all cases. The yield of fodder corn upon plat 6 was the third lowest in the scale including all plats; *i. e.*, 1,930 pounds per acre. It was also the poorest-looking crop upon field "A" during the larger portion of the season. The result shows, in a very striking manner, that the growing of plants does materially assist in rendering available the inherent mineral plant food of the soil. The growth of three years, although in our case exceptionally small, was lost to us. Our observation in this connection confirms the results of more recent careful investigations into older systems of agricultural practice. Black fallow, as a rule, does not materially benefit the productiveness of an exhausted soil, and ought to be discouraged, therefore, from a mere financial point, at present rates of rent.

The subsequent more detailed description of the field

work carried on during the past season, as well as the conditions of the crop at different stages of growth, upon different plats into which field "A" has been subdivided, will enable all parties interested in the experiment to draw their own conclusions regarding its teachings.

The entire field was ploughed twice, as in previous years,— in autumn, a short time after harvesting the crop, and early in the succeeding spring. The fertilizing materials, single or compound, wherever used, were applied broadcast, and slightly harrowed under some time before planting.

Plat 1. Received 50 pounds of muriate of potash (25 pounds of potassium oxide).

Plat 2. 50 pounds of nitrate of soda (7–8 pounds of nitrogen).

Plat 3. 100 pounds of dissolved bone-black (16–17 pounds of soluble phosphoric acid).

Plat 4. Nothing.

Plat 5. 97 pounds of magnesia sulphate.

Plat 6. Nothing.

Plat 7. 50 pounds of muriate of potash (25 pounds of potassium oxide).

Plat 8. 50 pounds of sulphate of ammonia (10 pounds of nitrogen).

Plat 9. 50 pounds of muriate of potash (25 pounds of potassium oxide.

Plat 10. 97 pounds of sulphate of potash and magnesia (25 pounds of potassium oxide) ; 100 pounds of dissolved bone-black (16–17 pounds of soluble phosphoric acid).

The corn (Clark) was planted in drills, May 29. The rows were three feet and three inches apart, and the kernels were dropped in the rows from twelve to fourteen inches apart, with six to eight seeds in a place. The entire field was subsequently kept clean from weeds by a frequent use of the cultivator or the hoe, as circumstances advised.

The young plants appeared above ground quite uniformly, June 5. They soon showed, however, marked differences in regard to the rate of growth upon different plats, and presented, as the season advanced, more or less striking differences in their general appearance.

HEIGHT OF CORN ON PLATS, IN INCHES (1888).

	June 27.	July 5.	July 12.	July 20.	July 27.	Aug. 3.	Aug. 10.	Aug. 17.	Aug. 24.
Plat 1, . .	8	8½	12	15	20	27	45	58	72
Plat 2, . .	7	7½	9	11	15	18	29	40	62
Plat 3, . .	7	9	12½	14½	19	22	34	41	45
Plat 4, . .	4½	5½	7	8½	12	14	20	25	35
Plat 5, . .	8	10	13½	17	23	30	45	60	72
Plat 6, . .	5	5½	6	6½	7	9	14	25	32
Plat 7, . .	8	10	15	19	26	36	56	67	74
Plat 8, . .	5	8	8½	10	13	15	19	25	29
Plat 9, . .	7	9	12	15	19	33	36	55	63
Plat 10, . .	9	13	17	20	30	49	72	85	84

A change in the color of the plants was first noticed at the beginning of July upon plat 6, and subsequently in those upon plat 8. Tassels appeared at about the same time on plats 1, 2, 3, 5, 7 and 9, and about three days later on plats 4, 6 and 8. An examination of the plants at the time of cutting, September 14, showed that those raised upon plats 2, 3, 4, 6 and 8 had either no ears or but a few imperfect ones, while those from plats 1, 5, 7 and 9 had more. Plat 10 had from two to three times as many as either of the last mentioned. The majority of the plats, with the exception of plat 10, had produced only small and imperfect ears.

The following tabular statement contains the exact results, as far as the character of the crop is concerned : —

	Height of Plants When Cut.	Weight of Stover.	Weight of Ears.
Plat 1, ...	72 inches.	559 lbs.	58 lbs.
Plat 2, ...	62 "	280 "	23 "
Plat 3, ...	45 "	150 "	0 "
Plat 4, ...	35 "	113 "	1 "
Plat 5, ...	72 "	510 "	54 "
Plat 6, ...	32 "	193 "	0 "
Plat 7, ...	74 "	626 "	50 "
Plat 8, ...	29 "	141 "	5 "
Plat 9, ...	63 "	487 "	66 "
Plat 10, ...	84 "	607 "	130 "

The experiment will be continued, with some modifications, for another year. As the condition of the soil in field "A" (see next page) becomes from year to year better known, its fitness for investigations of a similar character increases as time advances.

The photographic illustrations accompanying this chapter represent some of the most striking features noticeable in the growth of these plats. They illustrate in particular the striking influence of potash on the annual yield, and show the disadvantages of black fallow on the productiveness of farm lands.

The annual yield of crops of dry corn fodder is stated with reference to the same moisture, 48 per cent.

The crops raised during the years 1886, 1887 and 1888, on plats 1, 2, 6, 7 and 9, have served for our illustrations.

FIELD "A."

[1882, a meadow; 1883, planted with "Longfellow" corn; 1884, 1885, 1886, 1887 and 1888, planted with "Clark" corn.]

Number of Plat.	Fertilizers Applied.		Yield of Dry Fodder Corn.		Yield per Acre.
	1887.	1888.	1887.	1888.	1888.
			Lbs.	Lbs.	Lbs.
Plat 1, . .	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen), and 50 lbs. muriate potash (= 25 lbs. potassium oxide).	50 lbs. muriate potash (= 25 lbs. potassium oxide), ...	720	617	6,170
Plat 2, . .	Nothing, ...	50 lbs. nitrate of soda (= 7 to 8 lbs. nitrogen), .	165	303	3,030
Plat 3, . .	60 lbs. dried blood (= 7 to 8 lbs. nitrogen), 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), ...	240	150	1,500
Plat 4, . .	Nothing, ...	Nothing, ...	130	114	1,140
Plat 5, . .	50 lbs. ammonium sulphate (= 10 lbs. nitrogen), and 97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide).	97 lbs. sulphate magnesia, ...	635	564	5,640
Plat 6, . .	Fallow, ...	Nothing, ...	-	193	1,930
Plat 7, . .	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), and 50 lbs. muriate of potash (= 25 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	730	676	6,760
Plat 8, . .	Nothing, ...	50 lbs. sulphate of ammonia (= 10 lbs. nitrogen),	165	146	1,460
Plat 9, . .	50 lbs. muriate of potash (= 25 lbs. potassium oxide), .	50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	655	553	5,530
Plat 10, . .	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), and 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), .	940	737	7,370

EXPERIMENTS WITH CORN FODDER. FIELD A. PLAT 1.
(One-tenth of an acre.)

1886. 50 lbs. Sodium Nitrate (=7 to 8 lbs. nitrogen).
Yield of Dry Corn Fodder. 430 lbs.

1887. 50 lbs. Sodium Nitrate (=7 to 8 lbs. Nitrogen) and 50 lbs. Muriate of Potash (=25 lbs. potassium oxide).
Yield of Dry Corn Fodder, 720 lbs.

1888. 50 lbs. Muriate of Potash (=25 lbs. Potassium Oxide).
Yield of Dry Corn Fodder, 617 lbs.

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1886. No Fertilizer.
Yield of Dry Corn Fodder, 250 lbs.

1887. No Fertilizer.
Yield of Dry Corn Fodder, 165 lbs.

WRIGHT & POTTER PRINTING CO., STATE PRINTERS.

1888. 50 lbs. Sodium Nitrate (= 7 to 8 lbs Nitrogen).
Yield of Dry Corn Fodder, 303 lbs.

A field with complete manure, consisting of Barn-yard manure and potash Salts.

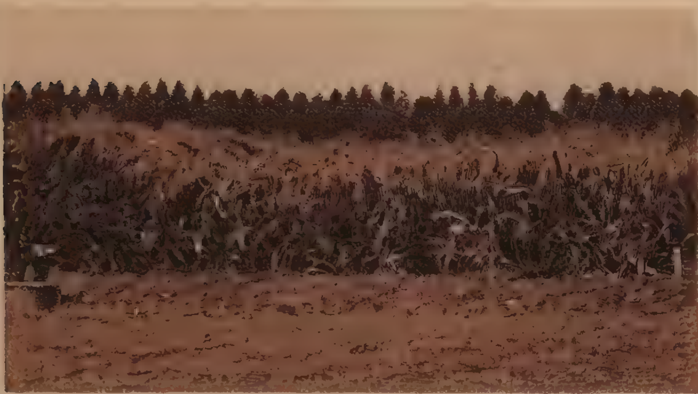
Yield of Dry Corn Fodder, 2800 lbs..

Plat 6. 1888. Was kept free from any vegetation from 1885 to 1888; and planted in 1888 with corn without receiving any manurial matter.

Yield of Dry Corn Fodder, 193 lbs.

WRIGHT & POTTER PRINTING CO., STATE PRINTERS

EXPERIMENTS WITH CORN FODDER. FIELD A, PLAT 7.



1886. 100 lbs. Dissolved Bone-black (= 17 lbs. available phosphoric acid). Yield of Dry Corn Fodder. 255 lbs.

1887. 100 lbs. Dissolved Bone-black (= 17 lbs. available phosphoric acid) and 50 lbs. Muriate of Potash (= 25 lbs. Potassium Oxide). Yield of Dry Corn Fodder. 730 lbs.

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1888. 50 lbs. Muriate of Potash (= 25 lbs. of Potassium Oxide). Yield of Dry Corn Fodder. 676 lbs.

1886. 50 lbs. Muriate of Potash (= 25 lbs. Potassium Oxide).
Yield of Dry Corn Fodder. 840 lbs.

1887. 50 lbs. Muriate of Potash (= 25 lbs. Potassium Oxide).
Yield of Dry Corn Fodder. 655 lbs.

WRIGHT & POTTER PRINTING CO., STATE PRINTERS

1888. 50 lbs. Muriate of Potash (= 25 lbs. Potassium Oxide).
Yield of Dry Corn Fodder, 553 lbs.

II. Influence of Fertilizers on the Quantity and Quality of Prominent Fodder Crops.

[Field "B."]

The field assigned to the above-stated inquiry is located west of field "A," and has been used, like the latter, for several years previous to the establishment of the Experiment Station, for the production of hay. The land is nearly on a level, and runs from north to south; it occupies at the present time an area of 1.7 acres. The soil consists of a somewhat sandy loam. During the spring of 1883 it was ploughed and prepared for raising corn fodder. This crop was raised for one year in drills, and without the aid of any manurial matter. The previous thorough mechanical treatment of the soil, as well as its impoverished condition, was considered favorable for the contemplated work. In 1884 the entire field was subdivided into eleven plats of equal size, with five feet of space between them. Every alternate plat has received from that date annually the same kind and same amount of fertilizer, — six hundred pounds of ground bones and two hundred pounds of muriate of potash per acre. The fertilizer has been applied at an early date each spring, either broadcast or between the rows, as circumstances admitted. It was in each case subsequently slightly harrowed under. Since 1885, all crops on that field have been raised in rows; this system of cultivation became a necessity in the case of grasses, clovers, etc., to secure a clean crop for observation. The rows, in the case of corn and leguminous plants, were three feet and three inches apart; and in the case of grasses, two feet. The space between the different plats measured five feet; it has received thus far no manurial substance of any description, and is kept clean from vegetation by a proper use of the cultivator. Plats 11, 13, 15, 17, 19 and 21 are fertilized annually; plats 12, 14, 16, 18 and 20 have received thus far no fertilizer. The single plats are either occupied by one variety of plants or by two; in some instances several plats are used for one and the same crop. Corn and various prominent varieties of meadow grasses and of leguminous plants have thus far been selected for observation.

The details of the work carried on upon field "B" are from year to year recorded in the annual report of the Station. As the chemical analyses of the crops raised require considerable time, on account of other contemporary pressing engagements in the laboratory, they are usually published in bulletins and the reports of the succeeding year. These analyses may claim a special interest, as they are made of a variety of fodder crops, raised, as far as practicable, under corresponding circumstances with reference to climate, to soil, to system of manuring, to the adopted modes of cultivation, of harvesting and of analyzing. In making this statement, I do not mean to imply that our local conditions of climate and of soil are in every instance the most favorable ones to enable the various crops here on trial to attain in all cases the highest possible development. This qualification of our results applies with more or less propriety to some varieties of grasses as well as of leguminous plants.

The subsequent tabular record of the crops raised upon the different plats of field "B" since 1884 may assist in a desirable understanding of its past history and its condition at the beginning of the season of 1888. The single plats are, since 1886, each 175 feet long and 33 feet wide.

STATEMENT OF CROPS RAISED ON FIELD "B."

PLATS.	1884.	1885.	1886.	1887.
PLAT 11 (fertilized)	Orchard grass (*Dactylis glomerata*), Meadow fescue (*Festuca pratensis*)	Orchard grass, Meadow fescue	Orchard grass, Meadow fescue	Corn.
PLAT 12 (unfertilized)	Orchard grass, Meadow fescue	Orchard grass, Meadow fescue	Orchard grass, Meadow fescue	Corn.
PLAT 13 (fertilized)	Hungarian grass (*Panicum Germanicum*), Pearl millet (*Penicillaria spicata*)	Hungarian grass, Pearl millet	Hungarian grass, Pearl millet	Italian rye-grass (*Lolium Italicum*). English rye-grass (*Lolium perenne*).
PLAT 14 (unfertilized)	Hungarian grass, Pearl millet	Hungarian grass, Pearl millet	Hungarian grass, Pearl millet	Italian rye-grass. English rye-grass.
PLAT 15 (fertilized)	Timothy (*Pleum pratense*), Red-top (*Agrostis vulgaris*)	Timothy, Red-top	Timothy, Red-top	Five varieties Southern cow-pea.
PLAT 16 (unfertilized)	Timothy, Red-top	Timothy, Red-top	Timothy, Red-top	Five varieties Southern cow-pea.
PLAT 17 (fertilized)	Corn (variety, Clark)	Corn	Corn	Meadow fescue.
PLAT 18 (unfertilized)	Corn	Corn	Corn	Alsike clover (*Trifolium hybridum*). Medium red clover (*Trifolium pratense*).
PLAT 19 (fertilized)	Corn	Corn	Corn	Alsike clover. Medium red clover.
PLAT 20 (unfertilized)	Corn	Corn	Corn	Mammoth red clover (*Trifolium medium*). Alfalfa or lucerne (*Medicago sativa*).
PLAT 21 (fertilized)	Corn	Corn	Corn	Mammoth red clover. Alfalfa.

1888. — At the beginning of the season but few changes became necessary in the management of the field; for, plats 13, 14, 17, 18, 19, 20 and 21 being still occupied by a perennial vegetation, only plats 11, 12, 15 and 16 required particular attention in that direction. It was decided to add the Kentucky blue-grass (*Festuca pratensis*) and the Soja bean (*Soja hispida*) to our list of prominent crops on trial upon field "B."

Plats 11 and 12 were seeded down, in drills two feet apart, with Kentucky blue-grass; and plats 15 and 16 with Soja beans, in rows three feet and three inches apart, to correspond with the rule adopted for grasses and leguminous plants. In both instances one plat was fertilized in the same way as heretofore, with fine-ground bones and muriate of potash (11 and 15), and the other two (12 and 16) received no fertilizer. The Kentucky blue-grass was seeded down rather late, May 24, and the Soja beans May 18. The mechanical condition of the soil was in both cases very satisfactory for the work.

Those plats which were still occupied by perennial plants, planted in preceding years, were treated between the rows at an early date with the cultivator, and subsequently the weeds and foreign growth in the rows removed with the hoe and the hand. Plats 13, 17, 19 and 21 received at the same time their annual supply of manure, consisting of fine-ground bones and muriate of potash. Plats 14, 16, 18 and 20 received none.

As the plats were 175 feet long and 33 feet wide, equal to an area of 5,775 square feet, each received a mixture of 80 pounds of ground bones and 27 pounds of muriate of potash.

The subsequent enumeration of crops raised upon field "B," during the years 1887 and 1888, shows the change made in crops at the beginning of the past season.

	1887.	1888.
Plat No. 11 (fertilized), .	Corn (Clark variety).	Kentucky blue-grass.
Plat No. 12 (unfertilized),	Corn (Clark variety).	Kentucky blue-grass.
Plat No. 13 (fertilized), .	Italian rye-grass (*Lolium Italicum*). English rye-grass (*Lolium perenne*).	Italian rye-grass. English rye-grass.
Plat No. 14 (unfertilized),	Italian rye-grass. English rye-grass.	Italian rye-grass. English rye-grass.
Plat No. 15 (fertilized), .	Five varieties Southern cow-pea.	Soja bean.
Plat No. 16 (unfertilized),	Five varieties Southern cow-pea.	Soja bean.
Plat No. 17 (fertilized), .	Meadow fescue (*Festuca pratensis*).	Meadow fescue.
Plat No. 18 (unfertilized),	Alsike clover. Medium red clover.	Alsike clover. Medium red clover.
Plat No. 19 (fertilized), .	Alsike clover. Medium red clover.	Alsike clover. Medium red clover.
Plat No. 20 (unfertilized),	Mammoth red clover. Alfalfa (lucerne).	Mammoth red clover. Alfalfa.
Plat No. 21 (fertilized), .	Mammoth red clover. Alfalfa (lucerne).	Mammoth red clover. Alfalfa.

The general appearance of the plats seeded down in preceding years with perennial varieties of grasses and of leguminous plants presented some interesting features at the opening of the late season. Some crops had suffered seriously from winter-killing, while others had passed unharmed through the winter. Wherever the growth had suffered, the fact showed itself invariably in the most serious degree upon unfertilized plats.

Perennial rye-grass, plat 14 (unfertilized), was almost entirely winter-killed; while upon plat 13 (fertilized) a much less serious effect could be noticed.

Italian rye-grass looked decidedly better preserved in both instances than the perennial rye-grass.

Meadow fescue, plat 17 (fertilized), appeared remarkably vigorous, and retained the lead for the entire season, as far as the varieties of grasses on trial are concerned.

Alsike clover was seriously winter-killed upon the unfertilized plat 18, while upon the fertilized plat 19 it was very well preserved.

Medium red clover appeared in fair condition upon plat 18 (unfertilized), yet fell behind the alsike clover on plat 19 (fertilized).

Alfalfa and *mammoth clover*, on plats 20 and 21, presented the same features in their growth as was noticed with reference to alsike clover and medium clover.

The weight of the hay obtained from the first cut of each kind of crop, when well advanced in blooming, gives a fair representation of their general character and condition at the time of harvesting. The yield is in every instance stated with reference to an entire plat (175×33 feet), in case of fertilized as well as unfertilized ones.

GRASSES.

	English Rye-Grass, cut July 5, 1888.	Italian Rye-Grass, cut July 5, 1888.	Meadow Fescue, cut July 2, 1888.
Fertilized plat, . .	300 lbs.	260 lbs.	700 lbs.
Unfertilized plat, . .	90 "	105 "	No plat.

LEGUMINOUS PLANTS.

	Medium Red Clover, cut July 5, 1888.	Alsike Clover, cut July 5, 1888.	Mammoth Red Clover, cut July 5, 1888.	Alfalfa, cut July 5, 1888.
Fertilized plat, . .	690 lbs.	490 lbs.	460 lbs.	150 lbs.
Unfertilized plat, .	250 "	70 "	20 "	50 "

SOJA BEAN (GREEN).

Cut Aug. 30, 1888.

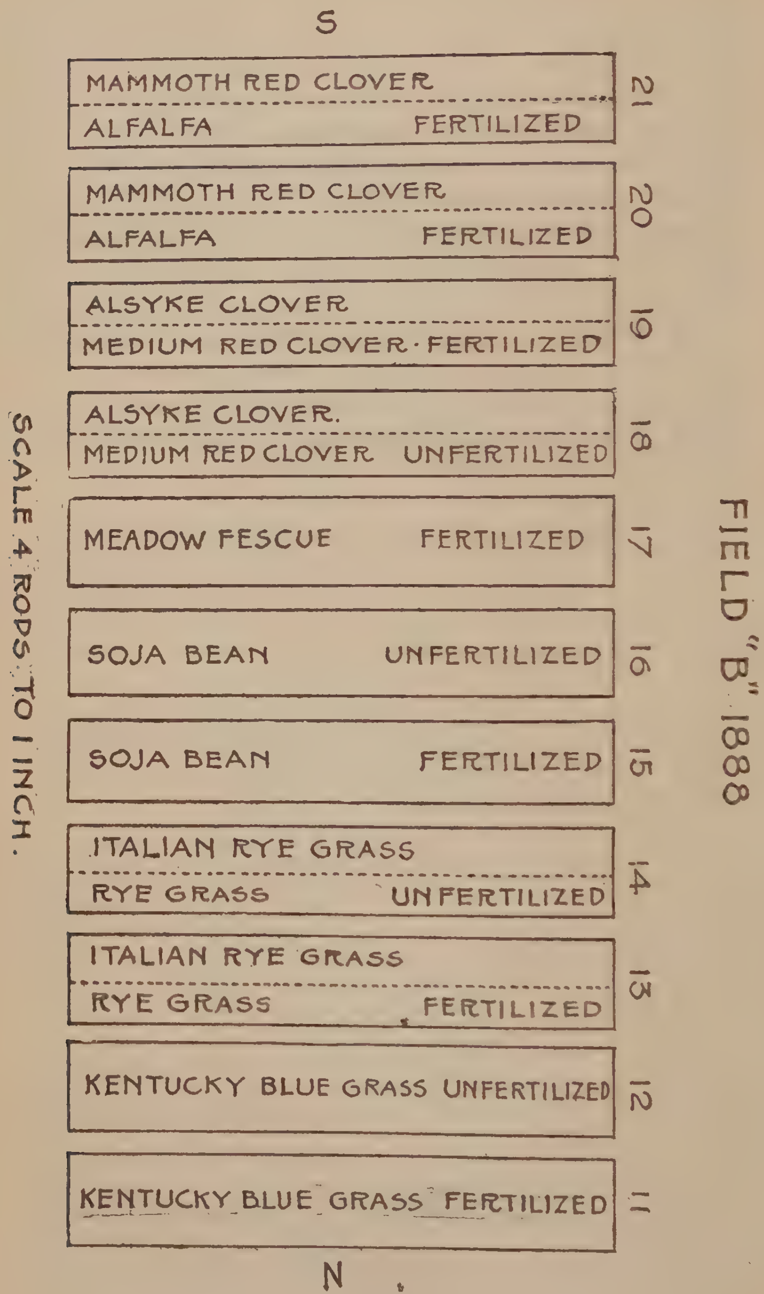
Fertilized plat, ...	2,080 lbs.
Unfertilized plat, ...	1,560 "

(The crop was put into a silo Aug. 30, 1888.)

The Soja bean has been raised during the past season in different parts of the field, to serve for ensilage. The investigation of this valuable plant is not yet finished, and a detailed description has been reserved for a future date.

As the cultivation in rows is an exceptional one as far as meadow grasses and clovers are concerned, no attempt has been made to state their yield per acre. The principal aim of the experiment on field "B" consists, as has been stated above, in securing suitable samples of each crop on trial, for the purpose of ascertaining the influence of stage of growth and of a different degree of fertility of the soil on their composition. Sufficient material has been collected of every crop stated above, and the results of a chemical analysis of each will be published from time to time as the work advances.

The analyses of alfalfa and of alsike clover of the first year's growth (1887) have been already published in the annual report for that year; also analyses of orchard grass, red-top, meadow fescue and timothy. (See pages 125–132.)


S
MAMMOTH RED CLOVER
ALFALFA FERTILIZED
21
MAMMOTH RED CLOVER
ALFALFA FERTILIZED
20
ALSYKE CLOVER
MEDIUM RED CLOVER · FERTILIZED
19
ALSYKE CLOVER.
MEDIUM RED CLOVER UNFERTILIZED
18
MEADOW FESCUE FERTILIZED
17
SOJA BEAN UNFERTILIZED
16
SOJA BEAN FERTILIZED
15
ITALIAN RYE GRASS
RYE GRASS UNFERTILIZED
14
ITALIAN RYE GRASS
RYE GRASS FERTILIZED
13
KENTUCKY BLUE GRASS UNFERTILIZED
12
KENTUCKY BLUE GRASS FERTILIZED
11
N
SCALE 4 RODS TO 1 INCH.
FIELD "B" 1888

III. Experiments with Fodder Crops for Green Fodder.

[Field "C."]

In a discourse on fodder supply for dairy cows, in the preceding annual report, pages 89, 90, the following statement was made : —

The practice of raising a greater variety of valuable crops for green fodder deserves the serious consideration of farmers engaged in the dairy business; for it secures a liberal supply of healthy, nutritious fodder, at a time when hay becomes scarce and costly, and when it would be still a wasteful practice to feed an imperfectly matured green fodder corn. The frequently limited area of land fit for a remunerative production of grasses, and the not less recognized exhausted condition of a large proportion of natural pastures, make it but judicious to consider seriously the means which promise not only to increase, but also to cheapen, the products of the dairy.

A liberal introduction of reputed forage crops into farm operations has everywhere, in various directions, promoted the success of agricultural industry. The desirability of introducing a greater variety of fodder plants into our farm management is generally conceded. In choosing plants for that purpose, it seems advisable to select crops which would advantageously supplement our leading fodder crop (aside from the products of pastures and meadows), — the fodder corn and corn stover.

Taking this view of the question, the great and valuable family of leguminous plants, as clovers, vetches, lucerne, serradella, peas, beans, lupines, etc., is, in a particular degree, well qualified for that purpose. They deserve also a decided recommendation in the interest of a wider range, for the introduction of economical systems of rotations, under various conditions of soil, and different requirements of markets. Most of these fodder plants have an extensive root system, and, for this reason, largely draw their plant food from the lower portion of the soil. The amount of stubble and roots they leave behind after the crop has been harvested is exceptionally large, and decidedly improves both the physical and chemical condition of the soil. The lands are consequently better fitted for the production of shallow-growing crops, as grains, etc. Large productions of fodder crops assist in the economical raising of general farm crops; although the area devoted to cultivation is reduced, the total yield of the land is usually more satisfactory.

Each farmer ought to make his selection, from among the various fodder plants, to suit his individual resources and wants; yet, adopting this basis as his guide, he ought to make his selection on the basis that the crop which is capable of producing, for the same area, the largest quantity of nitrogen containing food constituents, at the least cost, is, as a rule, the most valuable one for him.

Our prominent fodder plants may be classified, in regard to the relative proportion of their nitrogenous organic food constituents to their non-nitrogenous organic food constituents (nutritive ratio), in the following order: —

1.	Leguminous plants, clover, vetch, etc., . .	1 : 2.2 to 1 : 4.5
2.	Grasses, ...	1 : 5.0 to 1 : 8.0
3.	Green corn, roots and tubers, ...	1 : 6.0 to 1 : 15.0

The composition of the various articles of food used in farm practice exerts a decided influence on the manurial value of the animal excretions, resulting from their use in the diet of different kinds of farm live stock. The more potash, phosphoric acid, and, in particular, nitrogen, a fodder contains, the more valuable will be, under otherwise corresponding circumstances, the manurial residue left behind, after it has served its purpose as a constituent of the food consumed.

As the financial success in most farm management depends, in a considerable degree, on the amount, the character and the cost of the manurial refuse material secured in connection with the special farm industry carried on, it needs no further argument to prove that the relations which exist between the composition of the fodder and the value of the manure resulting deserve the careful consideration of the farmer, when devising an efficient and at the same time an economical diet for his live stock.

Believing in the correctness of the previous remarks, it has been one of the aims of the manager of the Station to experiment with various new fodder crops, to ascertain their adaptation to our climate and soil, and their fitness for the support of the dairy industry at a period of the season when good hay is scarce, and when the green fodder corn has not yet reached a desirable condition to do its best.

Some, as the vetch, Southern cow-pea and serradella, have been cultivated for several years past on a comparatively large scale, with marked success. They yielded a

liberal amount of green fodder from the beginning of June to the beginning of October. Their good services as green fodder for milch cows during that period have been described in the last annual report (1887, pages 35–48). Similar results have been obtained in this direction during the past season. The details of the feeding experiment form a part of this report.

The observations with reputed fodder crops have been extended during the past year; most of them were, however, raised on a small scale, to ascertain merely their general character and their particular degree of adaptation to our climate and soil, and to secure material for analysis, to compare their relative proportions of essential nutritive constituents.

The fact, as has been stated before, that all these crops are raised under corresponding conditions, as far as climate, soil, modes of cultivation and of fertilization and particular stages of growth are concerned, imparts to the results the claim of an exceptional value to decide judiciously their comparative merits.

1888. — Field "C" comprises at present an area 328 feet long and 183 feet wide. It was ploughed the previous fall, and again April 26; it was harrowed soon after, and fertilized broadcast at the rate of six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash per acre. The field is divided into two parts, running from east to west; they are separated from each other by a passageway three feet wide.

The northern half of the field is 70 feet wide and 328 feet long; the southern half is of the same length, but 110 feet wide.

The latter is again sub-divided into three equal plats, each 111 × 109 feet, or 11,990 square feet. The east end of this field was planted with a mixture of vetch (*vicia sativa*) and of oats (variety, western). The middle division was planted the same day with serradella, and the western with Southern cow-pea. Vetch and oats were seeded broadcast, and serradella and Southern cow-pea in drills, three feet three inches apart. The northern half of field "C" was occupied by a series of crops in rows,

running from south to north, three feet three inches apart, with the exception of the carrots, which were planted in rows fourteen inches apart. The crops were arranged in the following order, beginning on the east end : —

Danvers carrots, ninety rows.
Welcome oats, three rows.
Hairy vetch (*Vicia villosa*), one row.
Small pea (*Lathyrus sativus*), one row.
Sulla (*Hedysarum coronaria*), one row.
Bird's-foot clover (*Lotus corniculatus*), three rows.
Lotus villosus, three rows.
Sweet clover (*Melilotus alba*), three rows.
Early cow-pea, one row.
Teosinte (*Euchlæna euxurians*), two rows.
Flour corn, one row.
Pop-corn, striped rice, one row.
Chinese sugar cane, seven rows.
Early orange cane, fifteen rows.
Early amber cane, fifteen rows.

The seeds of the plants, with the exception of the carrots, serradella, vetch and Southern cow-pea, were sent on by the United States Department of Agriculture.

Vetch and Oats. — Twenty-five pounds of vetch and fifty pounds of oats were seeded broadcast May 8. The oats appeared above ground May 15, the vetch on May 17. The oats began to head out and the vetch to bloom June 30. Both crops had reached a height of 28 inches July 5, and of 32 inches July 12. The feeding of the crop began July 7 and terminated July 23. The total yield of the green crop amounted to 5,276 pounds, or 8.53 tons, per acre.

Southern cow-peas were seeded in rows, three feet and three inches apart, May 14. They appeared above ground May 28. The plants were six inches high June 27 ; twelve inches high July 12 ; and twenty inches high August 3. They began to fill out the space between the rows August 10 ; bloomed August 17, and formed pods August 23. The feeding of the crop commenced September 4, and was finished September 15. The crop had suffered somewhat from frost September 7. The total yield amounted to 4,050 pounds, or 7.36 tons, per acre.

Serradella was planted in rows, three feet three inches apart, May 14. The young plants appeared above ground May 26. They had reached a height of six inches July 5; began blooming July 12, and measured eleven inches, when a blight made its appearance on the leaves, which ultimately destroyed the crop to such an extent that no part of it was fed. The grounds occupied by the serradella had been used during the preceding season for the cultivation of different varieties of wheat, which seriously suffered from fungoid growth. The exceptionally wet season most likely contributed also towards the failure of the crop.

The early frost, September 7, terminated prematurely the observations on Chinese sugar cane, early orange cane and early amber cane.

Teosinte, pop-corn, flour corn, melilotus, sulla, hairy vetch and lotus, have been sampled for analysis.

The perennial varieties of leguminous plants are left in the field for observations during the coming season, when their special agricultural merits will be discussed.


FIELD "C"
E
CARROTS
VETCH AND OATS
MISCELLANEOUS FODDER CROPS
N
SERRADELLA
S
CHINESE SUGAR CANE
EARLY ORANGE SUGAR CANE
COW PEA
EARLY AMBER SUGAR CANE
W
SCALE 4 RODS TO 1 INCH

IV. Experiments with Potatoes.

The experiments reported in this connection are continuations of those described under the same heading in our last annual report.

One of the experiments has been carried on upon the same portion of field "D" since 1884. It was originally instituted for the purpose of studying the effects of high-grade German potash salts, muriate of potash and potash magnesia sulphate, as the main potash source of plant food, on the quantity and the quality of potatoes raised by their assistance.

The second one, observations with scabby potatoes, owes its origin to the interest created by some observations made in connection with the former; it was carried on, for important reasons, upon a different part of the farm.

A. Observations upon Field "D."

[Variety: Beauty of Hebron.]

An examination of the preceding records of this experiment cannot fail to show that our original plan has been seriously interfered with by an early and persistent appearance of either scab or blight, or of both combined. The scab appeared in some parts of the field sooner than in others, — in the fertilized part of the soil sooner or more extensively than in the unfertilized soil. The results in 1884 were not as bad as in 1885. The seed potatoes used in 1885 were selected from our own crop; they were planted upon the same part of the field where they had been produced the preceding season. The system of manuring and of general treatment was the same as in the previous year. A blight on the leaves appeared that year in August, and terminated the experiment prematurely. The crop, when harvested August 26, was found suffering from scab in all parts of the field engaged in the experiment.

It was decided, in sight of these facts, to continue the experiment in 1886 upon the same field, with some modifications, to ascertain, if possible, whether the main influence regarding the results in our past observation had to be

ascribed to atmospheric agencies, or to the condition of the soil and the fertilizer applied, or to the quality of the seed potato used.

1886. — The same field was used as in 1885. The land was well prepared by ploughing and harrowing April 27, and subsequently fertilized the same as in previous years. The change regarding the character of the fertilizer applied consisted in using nearly twice the amount of potash salts, muriate and sulphate of potash, for the same area, in case of plats 1 and 3. A second important change from our previous practice consisted in securing first quality seed potatoes, in particular free from scab. The same variety, Beauty of Hebron, was obtained for that purpose from Vermont; it was as fair an article as could be desired. The system of planting and cultivating was the same as in previous years. The potatoes were planted upon all plats May 5, 1886. All the vines were in full blossom July 6; they began to turn yellowish and dry up July 30. The crop on the entire field was dried up August 8. This change seemed to appear most marked, and first, on the vines raised from whole potatoes. The crop was harvested August 28.

Neither a liberal use of our own mixture of commercial manurial substances, rich in potash compounds, nor the selection of a fair quality of seed potatoes from another locality, had affected our results, as compared with those of the previous season; for the entire crop, with scarcely any exception, was badly disfigured by scab. The potatoes were unfit for family use, and had to be sold at a low price for stock feeding.

A due consideration of all the circumstances which accompanied our course of observations thus far, induced us to draw the following conclusions: —

1. Medium-sized whole potatoes give better results, as far as a large-sized, marketable crop is concerned, than half potatoes obtained from tubers of a corresponding size.

2. Disregarding the results of the first year, when previously existing resources of plant food in liberal quantities

must have rendered the influences of an additional supply of manurial substances less marked, it appears that sulphate of potash produced better results in our case than muriate of potash.

3. The premature dying out of the vines, accompanied by blight or scab, or both, must be considered a controlling cause of an exceptionally large amount of small potatoes.

4. Some peculiar condition of the soil upon the lands used for this experiment is to be considered the real seat of our trouble. (For further details, see annual report.)

To test the correctness of conclusion 4 still further, the experiment was continued for another year.

1887. — The same plats as in previous years were utilized for the experiment. The subdivisions remained unchanged. The fertilizers applied were the same as in 1886.

The lands were ploughed and harrowed during the first week of May, and the potatoes planted in all plats May 11. First quality potatoes, Beauty of Hebron, raised in Vermont, were used as seed. The growth looked well upon all plats until July 28, when the vines on plats 2 and 3 began to turn yellow. They commenced drying up August 9, and by August 12 were dry on all plats. An examination of the little potatoes, July 1, showed already, in every case, the marks of scab.

The entire crop, when harvested, was so seriously affected by scab that it proved worthless in the general market.

The months of July and August were exceptionally wet and warm in our part of the State, a circumstance which has, most likely, aggravated our trouble.

The potato crop was in that year quite extensively a failure in our vicinity, wherever low lands had been used for its production.

1888. — The continued failure to raise upon this field a potato crop free from a serious attack of scab had strengthened our belief that neither the kind of fertilizer applied, nor

the particular character of the season, nor the quality of the seed potatoes used, had any special relation to our results; but that some peculiar feature of the soil would ultimately prove to be the cause of our trouble.

Assuming that the presence of some injurious parasite in our soil might be the first cause of the scab, it was decided to devise some means by which its development would be prevented. The following course was adopted: Three plats, each forty-four by seventy feet, corresponding in location with plats 1, 2 and 3 in our description of preceding years, were assigned for the observation.

Plat 1, located on the eastern side of the stated area, received the same manure and in the same proportion as in the preceding year (600 pounds of fine-ground bones and 580 pounds of potash-magnesia sulphate per acre). The plat thus fertilized was subsequently subdivided into two equal parts, of which one received broadcast a mixture of one-half a pound of bi-sulphide of carbon and of ninety-five pounds of air-slaked lime; while the other half received broadcast a mixture of one-half a pound of carbolic acid and of ninety-five pounds of air-slaked lime.

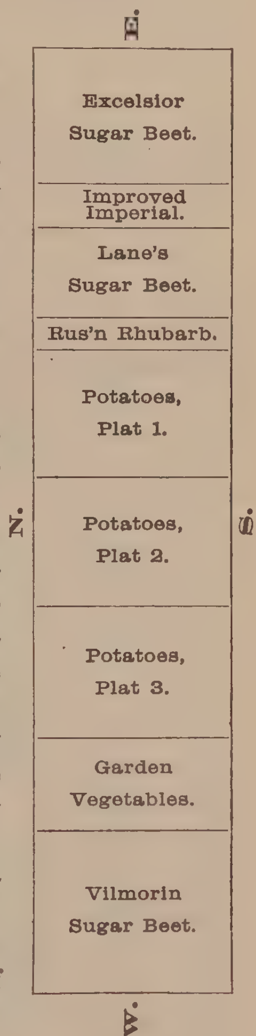
In both instances the soil was subsequently slightly harrowed before the potatoes were planted.

Plat 2, located between plats 1 and 3, received, as in previous years, no fertilizer; but one hundred and ninety pounds of air-slaked lime were sown broadcast and harrowed in before planting. The application of lime was made here to assist in discriminating between the influence of a mere application of air-slaked lime, and that of a mixture of either bisulphide of carbon or carbolic acid and air-slaked lime.

Plat 3, forming the western end of our experimental field, received for manuring purposes, as in the preceding years, fine-ground bones and muriate of potash, at the rate of 600 pounds of the former to 300 pounds of the latter per acre. The fertilizer was applied broadcast and slightly harrowed in. The plat thus prepared, in a similar way to plat 1, was

subsequently subdivided, like the latter, into two equal parts. One part was treated broadcast with a mixture of air-slaked lime and of bisulphide of carbon, and the other one with that of air-slaked lime and of carbolic acid, in the same way, as far as relative portions and total amount are concerned, before planting.

FIELD "D."*



* Scale, 4 rods to 1 inch.

The potatoes were planted on all the plats May 7; they appeared pretty uniform above ground May 27. The general treatment of the crop during the entire time was the same on all plats, and closely corresponded to the course pursued in preceding years. The vines began to change their color August 17, and were all dead August 31. The change seemed to be a natural one; no indications of blight could be discovered on the leaves; the extreme wetness of the season seemed to favor the continuation of the growing period. The crop on all the plats was harvested September 7. An examination of the entire crop, when spread out over the field, showed no marked difference in any particular part of the various plats. The potatoes were of a fair size, but seriously suffering from scab and rot.

Plat 1 yielded 1,080 pounds of potatoes; plat 2, 876 pounds, and plat 3, 976 pounds, of all sizes. Fifteen bushels of scabby potatoes, nearly one-third of the entire crop, were collected before the crop was removed from the field.

Although the results of the year are discouraging, the experiment will be repeated, with some modification, when a more favorable season may assist in the work.

B. Observations with Scabby Potatoes.

The experiments were inaugurated in 1886 for the purpose of inquiring into the circumstances which control the development and the propagation of the scab on potatoes.

1886. — The first year's work in this connection has been confined to the task of observing the behavior of scabby potatoes as seed potatoes, under some definite previous treatment. To prevent a possible propagation of scab in the new crop by infected seed potatoes, the following course was adopted: Thoroughly scabby potatoes, obtained from the previously described experimental plats, were treated with some substances known to be destructive to various forms of parasitic growth. This operation was carried out with the intention of destroying the propagating power of adherent germs of an objectionable character before planting the seed.

The field for the experiment was distinctly separate from other experimental plats for the cultivation of potatoes. It had been used for many years previous for the raising of grass, and had since been planted but once, — the preceding year (1885), — with corn. The land was prepared by ploughing and harrowing in the same way as other potato fields. It was fertilized broadcast, at the rate of 600 pounds of ground rendered bones and 290 pounds of potash-magnesia sulphate.

The field was subdivided into five plats of equal size, eighty feet long and fifty feet wide, and the potatoes subsequently planted in rows, three feet three inches apart, with hills three feet from each other in the rows. Three feet of space was left between the plats unoccupied. The scabby seed potatoes selected for the trial were, as far as practicable, of a uniformly medium size. Each lot was immersed in the particular solution prepared for the different plats; after being kept there for twenty-four hours they were removed and directly planted.

Plat 1 was planted with healthy and smooth potatoes, without any previous treatment. This course was adopted to learn whether soil, fertilizer, or atmospheric agencies of the season would favor the appearance of scab in the crop.

Plat 2. The scabby seed potatoes were allowed to remain for twenty-four hours in a saturated solution of muriate of potash before being planted.

Plat 3. A strong solution of hypochlorite of lime (bleaching lime) was applied in a similar way, for the preparation of the scabby seed, as in case of plat 2.

Plat 4. A saturated solution of carbolic acid in water served in this instance for the treatment of the scabby potatoes.

The potatoes were planted in all plats on the same day, May 7. The vines did not appear evenly at first; they were, however, equally vigorous upon all plats at the close of June.

The tops on all plats were pretty generally dried up August 8. The potatoes were harvested on the entire field August 30. The yield on all plats was fair, and the quality of the potatoes, almost without exception, excellent; this seemed to be more striking in regard to those on plats 2, 3 and 4, which had been, in the beginning of the season, somewhat behind in growth. Here and there could be seen a potato with a small mark of scab; a large proportion were perfectly smooth, and without any sign of it. The results were recorded as those of a first experiment.

The fact that a scabby potato may produce, under certain circumstances, a smooth and otherwise excellent potato, was confirmed. Good potatoes have been raised before from seed potatoes suffering from scab, without any previous treatment similar to ours. Without any intention of anticipating the results of future observations, or to point out with certainty the exact cause of our results, we expressed the opinion that a difference in the condition of the soil in our old and new experimental potato plats might have proved to be the principal cause of our trouble; for the former yielded, from healthy potatoes, most inferior scabby potatoes; while the latter produced, from scabby potatoes, a most superior, smooth potato, under otherwise almost identical conditions, as far as soil, mode of cultivation and kind of fertilizer were concerned, upon lands in close proximity, during the same season.

1887. — The experiment was repeated upon the same lands, with but a slight modification. The soil was ploughed and fertilized, as in the preceding year. Ten plats, each fifty feet long, were planted with four rows of potatoes, three feet three inches apart, and with nineteen hills in the row. Medium-sized, whole scabby potatoes (Beauty of Hebron), selected from the crop raised upon our own fields during the previous year, and which is described in some preceding pages under the heading "Potato Experiment, A," served as seed potatoes. One-half the plats were planted with scabby potatoes, all from the same lot, after being immersed for eighteen hours in some solution prepared for that purpose; and the other half were planted without any previous treatment of the seed, — plats 2, 6 and 10 with our scabby potatoes, Beauty of Hebron, and plats 4 and 8 with healthy, smooth tubers, of the same variety.

Plat 1. Scabby potatoes, soaked in a solution of potassium sulphide.
Plat 2. Scabby potatoes, without any particular treatment.
Plat 3. Scabby potatoes, treated with a solution of hypochlorite of lime (bleaching lime).
Plat 4. Smooth, healthy potatoes, without previous treatment.
Plat 5. Scabby potatoes, treated with a solution of potassium chloride (muriate of potash).
Plat 6. Scabby potatoes, without previous treatment.
Plat 7. Scabby potatoes, treated with a solution of carbolic acid.
Plat 8. Smooth, healthy potatoes, not treated.
Plat 9. Scabby potatoes, treated with copper sulphate (blue copperas).
Plat 10. Scabby potatoes, not treated.

The young plants made their appearance on all plats, except plat 9, June 1; those on plat 9 appeared eight or ten days later. The entire crop looked uniformly well. The vines dried up on all plats at about the same time. The crop was harvested with the following results: —

BEAUTY OF HEBRON.

PLAT.	Date of Planting.	Condition of Seed.	Solutions Used.	Results (Sept. 12, 1887).
No. 1,	May 12 to 14, 1887.	Scabby.	Potassium sulphide.	Good; not scabby.
" 2,		Scabby.	None.	Good; not scabby.
" 3,		Scabby.	Hypochlorite of lime (bleaching lime).	Especially good.
" 4,		Good.	None.	Somewhat scabby.
" 5,		Scabby.	Potassium chloride (muriate of potash).	Especially good.
" 6,		Scabby.	None.	Good; not scabby.
" 7,		Scabby.	Carbolic acid.	Especially good.
" 8,		Good.	None.	Especially good.
" 9,		Scabby.	Copper sulphide (blue copperas).	Only 7 hills left. More or less scabby.
" 10,		Scabby.	None.	Somewhat scabby.

A careful consideration of these results tends to show that a certain condition of the soil has been the leading cause for the origin and propagation of the scab; for scabby seed potatoes have produced healthy, smooth tubers, both with and without any special previous treatment (see plats 1, 2, 7 and 8). On the other hand, it is not without interest to notice that plats 1, 3 and 7 have furnished us with some of the best potatoes we have raised during the past season.

1888.— The field occupied by the experiment was the same as during the preceding year. The same arrangement of plats was adopted. The preparation of the soil, as far as ploughing and manuring are concerned, was the same as in the preceding season. The solutions of chemicals for the treatment of part of the seed potatoes was identical with that of the preceding year. All the details of the field work, beginning with planting and ending with harvesting, were closely corresponding to the course pursued in 1887.

The potatoes were planted May 9; the vines died on all plats, apparently without any exceptional external cause, between August 23 and 31. No marked difference could be noticed in the appearance of the potatoes from the various plats. All plats had produced some scabby potatoes. The

result of the season is, to say the least, an indifferent one, as far as the action of the various solutions of antiseptics as a preventive of scabby potatoes is concerned.

The conclusion arrived at in previous years has evidently received an additional support by the results of the past season. Every one of our observations thus far made in this connection points towards the soil as the bearer of the cause of the scab on potatoes. The inquiry into the first cause of the scab will be continued.

Those of our readers who are not familiar with the present views entertained by scientists regarding the real character of the scab on potatoes, will find Professor Humphrey's discussion of this subject, which accompanies this chapter of our annual report, very interesting and profitable reading.

It has been considered of interest to photograph the seed potatoes, and subsequently some specimens of a corresponding size of those raised from them. This course it is thought will furnish us in time with an exact record of the exterior characteristics of genuine varieties, and assist us in discriminating between new and old. As the Beauty of Hebron, Early Rose and Polaris (originated by H. F. Smith of Waterbury Centre, Vt.) have been the principal varieties raised upon the fields of the Station during the past season, their photographs accompany this report. A picture of the Colorado wild potato, raised on our lands, may not be without interest in this connection. The pictures are in every case taken at an equal distance, and thus allow a comparison of relative sizes.

Description of Photographs of Potatoes.

	Largest. Weight in ounces.	Medium. Weight in ounces.	Smallest. Weight in ounces.
Picture No. 1. Beauty of Hebron Potatoes,	7 to 19	3 to 6½	2½ to 3½
Picture No. 2. Early Rose Potatoes, . .	4 to 8	2½ to 3½	1½ to 2½
Picture No. 3. Polaris Potatoes, . .	6 to 11	3 to 5½	2 to 3
Picture No. 4. Colorado Wild Potatoes, .	–	–	–

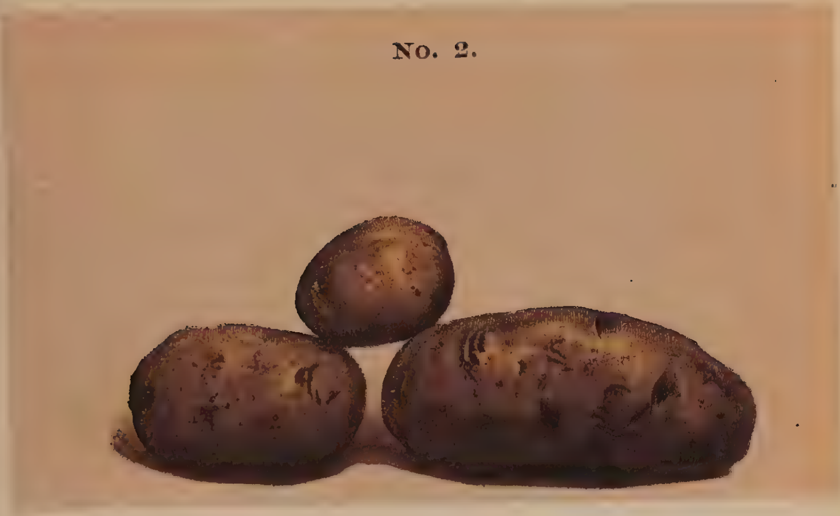
No. 1.

Beauty of Hebron (Seed Potatoes for 1888).

Wright & Potter Printing Co., State Printers

Beauty of Hebron (Potatoes Raised in 1888).

No. 2.



Early Rose (Seed Potatoes for 1888).

Wright & Potter Printing Co., State Printers.

Early Rose (Potatoes Raised in 1888).

No. 3.

Polaris (Seed Potatoes for 1888)

Polaris (Potatoes Raised in 1888).

No. 4.

Colorado Wild Potatoes (Raised in 1888).

POTATO SCAB.

BY JAS. ELLIS HUMPHREY, PROFESSOR OF VEGETABLE PHYSIOLOGY.

The value of the potato crop in Massachusetts exceeds that of any other planted crop; consequently, the loss by any widespread and serious disease of this crop must be an important item. The commonest and most constant disease which attacks the potato in the field is that commonly known as the "scab." It is well known in both Europe and America, and attacks the tubers, giving little or no evidence of its presence in those parts of the plant above ground. The cause of this trouble is not at all understood, though various theories are held as to its nature. It is proposed in the present paper to discuss briefly the present state of our knowledge of the potato scab, by way of introduction to a series of investigations of the disease which the writer expects to carry on during the coming year.

The disease first manifests itself in the form of small corroded spots or pustules on the surface of the potato. Writers on the subject generally agree that these spots replace the "lenticels" of the tubers.

If a smooth potato tuber be closely examined, there will be seen spots of the size of a pin's head or smaller, of a slightly different shade, and somewhat roughened or granular in appearance. These breaks in the continuity of the tissue of tabular cork-cells which form the so-called "skin" of the potato, are filled with loose, globular cork-cells, through whose intercellular spaces an interchange of gases can take place between the interior of the potato and the outer air. They are then, so to speak, the *ventilators* of the tuber, and are known as "lenticels." (The normal structure of the potato tuber is shown in the accompanying Fig. 2.) It is in these lenticels that the scab originates or first shows itself.

From these spots the disease rapidly spreads, until sometimes almost the whole exterior of the tuber becomes involved in the decay and breaking down of the surface tissue. In many cases, at least, there are developed over these patches, rough, brittle scales or crusts of corky tissue, which peel readily from the surface, and which render the name

"scab" an appropriate one for the disease. In Fig. 1 is shown the appearance of the fully developed scab, reproduced from photographs of potatoes raised on the plats of the Station in 1888. This whole change goes on while the tuber is still in the ground; and after the crop is dug and stored, no further change occurs. The disease affects the tissue to a depth of only a few cells, all below remaining in a normal, healthy condition. The cells affected lose their starch, and contain, in its place, according to some writers, globular brown masses, usually regarded as disorganized cell-contents. In so far as the starch, which gives its chief food value to the potato, is destroyed, that value is lessened; but the unsightly appearance of "scabby" tubers causes a much greater proportional decrease in their selling value, since, by paring away the affected superficial tissue, the remainder is made perfectly suitable for food.

The cause of this disease has been discussed by several writers. Most of the views expressed are based on the first important discussion of the subject by Schacht, in a work on the potato plant and its diseases.* This author believes that the efficient cause of the scab is an excess of moisture in the soil. It can readily be shown, that, when a potato tuber is exposed to an abundance of moisture, the lenticels become more prominent, in consequence of the loosening and separation of the cells which fill them. This affords, Schacht thinks, an easy opportunity for the water to enter those tissues of the tuber bordering the lenticels. They thus become water-soaked, and rapidly decay, assuming a dark and muddy appearance. Two of the chief recent writers on the diseases of plants, Frank and Sorauer, adopt this view. Frank † regards the disease as a case of breaking down of tissue, originating in what is practically a wound. Sorauer ‡ thinks the scab develops rapidly during short but specially favorable periods, and instances, as such a period, the time of a heavy rain following a drought. Each of the above writers mentions as a possible cause, or at least an aggravating condition, the presence of lime, marls, or especially

* Bericht über die Kartoffelpflanze und deren Krankheiten, Berlin, 1854, p. 24.
† Krankheiten der Pflanzen, Berlin, 1880, p. 140.
‡ Handbuch der Pflanzenkrankheiten, Berlin, 1886, vol. i, p. 227.

of iron oxide in the soil; and Sorauer thinks that ammonia set free from the soil may sometimes have a similar influence. Another authority, W. G. Smith,* considers that the chief cause is mechanical irritation, from the presence in the soil of corrosive substances; and states that a difference may often be noticed in the degree of scabbiness of potatoes from different parts of the same field, depending on the relative proportions of refuse in the soil of the different parts. Smith also says that one form of the disease may be caused either by long drought or by excess of moisture. All authors agree that the scab-like crusts, which characterize the disease in its complete development, originate from the natural effort of the plant to repair the injury to the tuber by a secondary formation of cork. Sorauer differs from the others quoted, in rejecting the theory of irritation or corrosion as a primary cause of the trouble. He quotes at length several experiments, conducted in German experiment stations and elsewhere, whose results seem to be conclusive against the idea that foreign substances in the soil can cause the disease by mechanical or chemical action.

We may now proceed to consider the bearing of some recent American observations on the views already stated. The only experiments undertaken in this country for the purpose of testing current theories, with which I am acquainted, are those of Arthur and Beckwith of the New York Experiment Station.† Plats of potatoes were planted and kept under identical conditions, except that half of the hills were kept wet by irrigation, while the others were not artificially watered. One-half of the hills of each class were planted without manure, and the remainder were manured. In the unmanured hills, abundant moisture had practically no influence, for the percentage of scabby potatoes was very nearly the same in the irrigated and unirrigated portions. On the other hand, the irrigated hills on the manured ground produced seventy-one per cent. of scabby tubers, against only thirty per cent. from the unwatered hills. A general average gives forty-eight per cent. of scabby tubers on the irrigated

* Diseases of Field and Garden Crops, London, 1884, p. 37.

† Sixth Annual Report of the New York Agricultural Experiment Station, 1888, pp. 307 and 344.

ground, to thirty-one per cent. on that unirrigated; and fifty-one per cent. of diseased ones on the manured ground, against twenty-two per cent. where manure was not used. These results indicate that an abundance of moisture favors the development of scab, but can hardly be held to support the view that it is the chief *cause* of the disease. Beckwith concludes from his experiments that an increased yield is nearly always accompanied by an increase of scab; and that any marked change in the rapidity of the growth of the tubers favors its development, a continuous growth from their first formation to maturity being least favorable to the appearance of the disease. The last point may, perhaps, be regarded as another aspect of Sorauer's view that a heavy rain after drought especially aids the development of scab.

Observations made at this Station during the past five years, and detailed in its reports,* also bear interestingly on the subject. The experiments were begun with a wholly different end in view, but were vitiated the first year by the appearance of scab, which has persistently appeared on the same plats in every succeeding year. The first year, when the land was freshly broken, the trouble was less severe, and a difference in severity was noticed on plats differently fertilized. Since the first year, the crop has been uniformly scabby, but not more so in wet than in drier seasons. The experiments thus far, while by no means conclusive in their results, seem to point to peculiar soil conditions as the most probable cause of the disease.

In 1887 there appeared a paper by a Norwegian naturalist, Brunchorst,† on a disease of potatoes common in that country, and there called "Skurv," which he believes to be, and which, from his description, seems to be, the same as the German "Schorf" and the English and American "scab." This writer states that the masses noticed by other investigators in the dead cells of the tuber, and by them supposed to be composed of disorganized cell-contents, are really the resting condition of a parasitic organism, whose attacks

* Second to Sixth Annual Reports of Massachusetts Agricultural Experiment Station, 1885–89.

† Ueber eine sehr verbreitete Krankheit der Kartoffelknollen. In Bergens Museums Aarsberetning for 1886, p. 219.

cause the disease. He describes in detail the structure of these masses, as he understands them, but has not seen the supposed parasite in its active state. He names the organism *Spongospora Solani*, and regards it as closely related to *Plasmodiophora Brassicae*, discovered by Woronin * in 1877, and now generally regarded as the cause of the so-called "club foot" or "stump root" disease of cabbages and turnips. For a better understanding of Brunchorst's theory, it may be well to give here a very brief account of the "club foot" parasite.

On emerging from its resting state under the influence of favorable conditions for vegetation, it appears as an almost inconceivably tiny, naked mass of protoplasm, with the power of moving or creeping about in moist soil. Here it may attack a young root of either of several plants of the Mustard family, most commonly of a cabbage or turnip. Penetrating a surface cell, it lives and grows at the expense of the contents of that cell, moving on to another when the first is exhausted. Cells thus attacked increase in size, in consequence of the abnormal stimulus caused by the presence of the parasite, which often also causes a large increase in the number of cells in the affected region. This hypertrophy produces the characteristic swellings which give the disease its name. As a result of the growth and fusion of the protoplasmic masses of the organism, many of the root-cells become at length filled by them. Each of these masses separates, toward the close of the season, into numerous very small globular ones, and each of the latter secretes a wall or coat about itself. In this condition the organism can survive considerable extremes of cold or dryness, and can await the recurrence of favorable conditions. When the weather again permits, the walls or coats crack open, and the contained bits of protoplasm emerge from their rest, each one taking up its active life, and repeating the cycle just outlined. Brunchorst believes the history of his *Spongospora* to be very similar to the above, differing chiefly in the fact that the numerous masses, into which the parasitic contents of one cell divide, remain angular and closely compacted into a spongy structure, instead of becoming

* Pringsheim's Jahrbücher für wissenschaftliche Botanik, vol. xi, p. 548.

globular and separate, as in *Plasmodiophora*. In Fig. 3 are shown the active and resting stages of the latter, and Brunchorst's representation of the resting state of his supposed scab parasite.

Both the New York and the Massachusetts observations, before referred to, bear on Brunchorst's views. If the scab is caused by a living organism, its development must be checked by the application of substances fatal to parasitic forms of life; and scabby potatoes would be expected to produce usually a scabby crop, when planted, the infected tubers infecting the new generation. Experiments with fungicides, at both stations named, gave only negative results, the decrease in scabbiness where they were used being insignificant. The average proportion of scabby tubers produced from scabby "seed" in the New York experiments was forty-five per cent, while smooth "seed" yielded thirty-seven per cent. of diseased potatoes. At our own Station the crops have varied little in quality, when raised under similar conditions, whether from smooth or scabby "seed;" and badly diseased tubers have, in several cases, produced exceptionally good crops.

One further observation, noted by Beckwith in the report quoted, is of interest. He finds that, while forty-three per cent. of the white-skinned potatoes and fifty-three per cent. of the flesh-colored ones raised on the station farm were scabby, only twenty-seven per cent. of the dark-skinned ones were affected. Assuming the cause of the disease to be external to the tuber, such a result was to be expected.

From the above statement, it is evident that much remains to be learned before our knowledge of the cause of the potato scab will be at all satisfactory. And, until a pretty definite knowledge of its cause is gained, all attempts at discovering a remedy are so many leaps in the dark. The conditions at this Station are in many respects very favorable for a hopeful prosecution of investigations into the nature and origin of the pest, which are planned for the coming season. The writer will be very glad of suggestions or reports of experience from persons who have had to do practically with the disease, or to communicate with any who are interested in this subject of inquiry.

FIG. 1.

WRIGHT & POTTER PRINTING CO., STATE PRINTERS.

Fig. 1. Two potatoes, "Beauty of Hebron," from Station plats, badly affected by "scab," illustrating the usual form of the disease. *From photographs.* Five-sixths natural size.

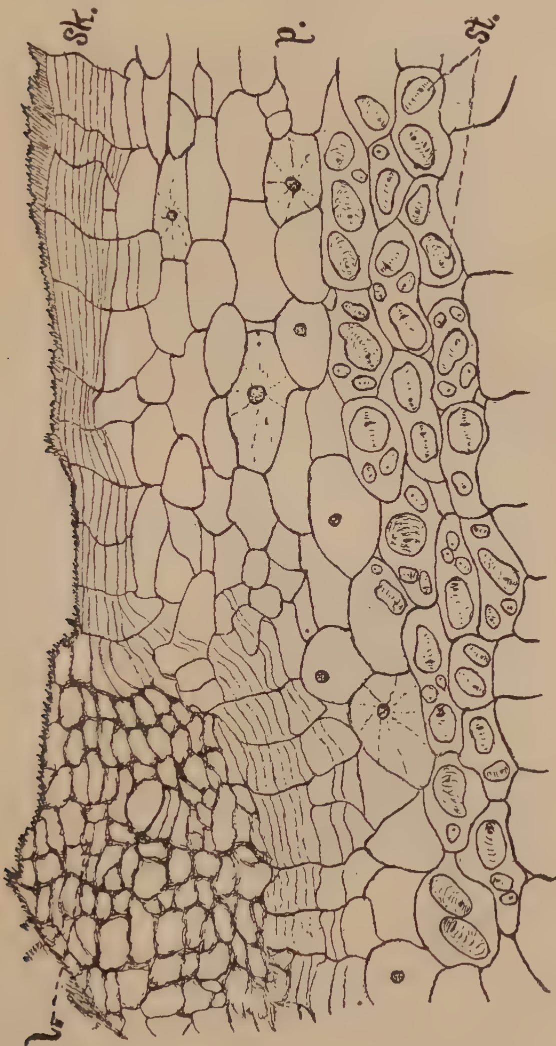


Fig. 2.

Fig. 2. Section taken at right angles to the surface of a healthy potato tuber, showing its normal structure.

sk. The "skin" of the tuber, of tabular cork-cells.

l. A lenticel, filled with rounded cork-cells.

p. The parenchymatous tissue, which forms the bulk of the tubers, containing starch-grains, *st.*

Original. Magnified one hundred diameters.

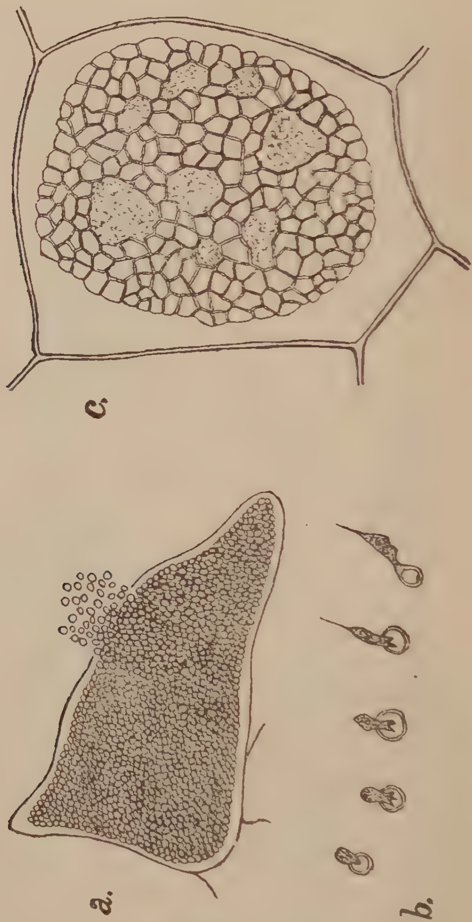


Fig. 3.

Fig. 3. *a.* Cell from diseased root of cabbage, showing resting stage of *Plasmodiophora Brassicae, Woronin*, the "club-foot" parasite.

b. Protoplasmic masses of *P. brassicae* emerging from the resting state.

c. Cell from scabby potato, showing resting stage of *Spongospora Solani, Brunchorst*, the supposed "scab" parasite.

a and b, after Woronin. *a* magnified one hundred diameters, *b* magnified six hundred diameters.

c, after Brunchorst. Magnified one thousand diameters.

V. Experiments with Root Crops.

The importance quite generally conceded to the introduction of a liberal cultivation of root crops in a mixed farm management, wherever a deep soil and the general character of the climate favors their normal development, rests mainly on the following consideration: They furnish an exceptionally large amount of valuable vegetable matter, fit for fodder for various kinds of farm live stock, competing in this direction favorably with our best green fodder crops; and they pay well, on account of large returns, for the necessary care bestowed upon them by a thorough, deep cultivation to meet success.

The physical condition of the soil, however favorable it may have been for the production of crops of a similar character, will suffer if year after year the same system of cultivation is carried out. Diversity in the mechanical treatment of the soil, and change of season for such treatment, cannot otherwise but affect advantageously its mechanical condition and the degree of its chemical disintegration, promoting thereby its fitness for developing inherent plant food, as well as its power of turning to account atmospheric resources of plant growth. The roots of the same plants abstract their food year after year from the same layer of soil, while a change of crops with reference to a different root system renders it possible to make all parts of the agricultural soil contribute in a desirable succession towards an economical production of the crops to be raised. Deep-rooting plants, like our prominent root crops, for this reason deserve a particular consideration in the planning of a rational system of rotation of crops.

To raise roots the second year, after a liberal application of coarse barn-yard manure, or the turning over of grass lands with the assistance of some commercial phosphatic fertilizer in the interests of a timely maturity, is highly recommended by practical cultivators of sugar beets. To stimulate in the roots the production of the largest possible amount of sugar and starch must be the object of the cultivator, for these two constituents of roots control, more than any other one, their increase in solids.

Root crops, although somewhat peculiar in their composition when compared with many of our prominent fodder articles, have proved a very valuable constituent in the diet of various kinds of farm live stock, when properly supplemented by hay, grain, oil cake, bran, etc., as circumstances may advise. Our experience at the Experiment Station confirms fully the valuable services of roots as an ingredient of fodder rations for milch cows. (For details on this point, see "Feeding Experiments with Milch Cows," in our fourth and fifth annual reports.)

The encouragement received on that occasion has served as an inducement to continue our work in this direction. The aim has been to experiment with the best varieties of roots at our disposal. The preceding annual report contains a short sketch of the field work carried out during the year 1887. The different varieties of roots raised had been photographed, and copies taken by the heliotype process accompanied the report. The discussion of their composition and of their comparative agricultural value had to be left for a later date, on account of the closing up of the annual report before that work was finished. The same course we are obliged to pursue, for the same reason, in regard to our field experiments with root crops during the late season (1888). Our present communication comprises, first, the analyses of roots raised in 1887; and second, a description of the work carried on in the field with different varieties of valuable roots for feeding purposes.

1. *Analyses of Roots raised upon the Lands of the Station in 1887.*

The seeds used in our experiments were sent on by the United States Department of Agriculture, with the exception of No. 7, — Saxony sugar beet, — which was taken from our collection of imported seeds. The field work was planned with a view to ascertain the general character and the particular composition of the different varieties of roots on trial, when raised, as far as practicable, under corresponding circumstances with reference to the peculiarity of season, the quality of soil, the system of manuring and the mode of cultivation.

The land consisted of a good loam in a fair condition of fertilization. It has been manured for several years past, annually, with a mixture consisting of six hundred pounds of fine-ground bone and two hundred pounds of muriate of potash per acre. The seeds, ten varieties in all, were sown May 25. Each variety occupied two rows across the field, of equal length (eighty feet).

No. 1. Beet, Mangel Wurzel, "Giant Long Red."
2. Beet, Mangel Wurzel, "Yellow Ovoid."
3. Beet, "Eclipse."
4. Beet, "Red Globe."
5. Beet, "Egyptian Turnip."
6. Beet, "Long Smooth Red."
7. Beet, "Saxony" Sugar Beet.
8. Turnip, Ruta-baga, "White Sweet German."
9. Turnip, "Early Yellow," or "Golden Stone."
10. Turnip, Ruta-baga, "Skirving's Purple Top."

The rows were three feet three inches apart. The young plants were in every case thinned out or transplanted, as circumstances advised, to about eight inches distant from each other in the rows.

The transplanting and thinning out took place between July 5 and 11; the weather during this time was favorable for transplanting. The seeds of Nos. 6 and 9 did not prove as good as the others; the young plants of Nos. 5 and 9, in particular, did not do as well after transplanting as the remainder.

The crop was harvested between October 31 and November 2. The roots, after being removed from the ground, were topped, and three of each kind were taken to the laboratory for a chemical examination, while three of an approximately corresponding size were photographed.

The three sample roots selected in each case represented, as far as practicable, the smallest, medium and largest of each variety raised.

The specimens selected for our fodder analyses were kept in the cellar, slightly covered with moist earth, until wanted for the chemical examination.

The photographs were taken in every case with the roots at an equal distance from the camera. (See illustrations, pages 148–150, in our last annual report.)

STATEMENT OF FIELD RESULTS.

NAME OF VARIETY.	Number of Rows.	Number of Roots.	Weight of Roots.	Weight of three Samples photographed.
			lbs.	lbs.
1. Mangel Wurzel, "Giant Long Red,"	2	150	365	11.75
2. Mangel Wurzel, "Yellow Ovoid,"	2	177	350	9.75
3. Beet, "Eclipse,"	2	163	285	4.
4. Beet, "Red Globe,"	2	173	335	7.5
5. Beet, "Egyptian Turnip,"	2	146	170	8.75
6. Beet, "Long Smooth Red,"	2	145	185	5.
7. Sugar Beet, "Saxony,"	2	144	314	8.75
8. Ruta-baga, "White Sweet German,"	2	176	445	4.
9. Turnip, "Early Yellow," or "Golden Stone,"	2	43	50	5.5
10. Ruta-baga, "Skirving's Purple Top,"	2	140	295	12.75

BEETS.

[I. Mangel Wurzel, "Giant Long Red," weight, 2 lbs. II. Mangel Wurzel, "Yellow Ovoid," weight, 2 lbs. 3 oz. III. "Eclipse," weight, 1 lb. 4 oz.]

	PER CENT.		
	I.	II.	III.
Moisture at 100° C.,	86.92	87.66	Not determined.*
Dry matter,	13.08	12.34	
	100.00	100 00	
Analysis of Dry Matter.			
Crude ash,	8.35	11.01	8.86
" cellulose,	9.54	7.21	4.29
" fat,	.90	1.01	.85
" protein (nitrogenous matter),	7.83	10.45	10.09
Non-nitrogenous extract matter,	73.38	70.32	75.91
	100 00	100.00	100.00

* The sample had suffered a loss in original moisture from exposure.

Fertilizing Ingredients in the Above Beets.

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	86.92	87.66	–
Nitrogen,	.171	.206	.282
Phosphoric acid,	.102	.085	.156
Potassium oxide,	.305	.462	.587
Calcium oxide,	.064	.059	.062
Magnesium oxide,	.047	.031	.045
Sodium oxide,	.145	.105	.055
Ferric oxide,	.006	.004	.005
Insoluble matter,	.028	.018	.043
Valuation per 2,000 lbs.,	$0 94	$1 17	$1 62

Beets.

[IV. "Red Globe," weight, 1 lb. 2 oz. V. "Egyptian Turnip," weight, 1 lb. 2 oz. VI. "Long Smooth Red," weight, 1 lb. 10 oz.]

	Per Cent.		
	IV.	V.	VI.
Moisture at 100° C.,	86.95	85.80	85.49
Dry matter,	13.05	14.20	14.51
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	10.57	5.80	8.99
" cellulose,	4.52	6.23	5.47
" fat,	1.76	.82	.79
" protein (nitrogenous matter),	12.17	7.82	11.80
Non-nitrogenous extract matter,	70.98	79.33	72.95
	100.00	100.00	100.00

Fertilizing Ingredients in the Above Beets.

	Per Cent.		
	IV.	V.	VI.
Moisture at 100° C.,	86.95	85.80	85.49
Nitrogen,	.264	.177	.236
Phosphoric acid,	.079	.070	.087
Potassium oxide,	.525	.303	.377
Calcium oxide,	.044	.049	.040
Magnesium oxide,	.025	.035	.044
Sodium oxide,	.110	.061	.099
Ferric oxide,	.004	.002	.003
Insoluble matter,	.013	.018	.028
Valuation per 2,000 lbs.,	$1 42	$0 92	$1 20

Sugar Beet.

[VII. "Saxony," weight, 1 lb. 11 oz.]

	Per cent.
Moisture at 100° C.,	83.32
Dry matter,	16.68
	100.00

Analysis of Dry Matter.

Crude ash,	5.09
" cellulose,	5.81
" fat,	.39
" protein (nitrogenous matter),	7.32
Non-nitrogenous extract matter,	81.39
	100.00

Fertilizing Ingredients in Sugar Beet.

Moisture at 100° C.,	83.32
Nitrogen,	.209
Phosphoric acid,	.136
Potassium oxide,	.383
Calcium oxide,	.052
Magnesium oxide,	.034
Sodium oxide,	.113
Ferric oxide,	.025
Insoluble matter,	.032
Valuation per 2,000 lbs.,	$1 18

Turnips.

[VIII. Ruta-baga, "White Sweet German," weight, 2 lbs. 2 oz. IX. "Early Yellow" or "Golden Stone," weight, 14 oz. X. Ruta-baga, "Skirving's Purple Top," weight, 2 lbs. 11 oz.]

	Per Cent.		
	VIII.	IX.	X.
Moisture at 100° C.,	87.23	87.20	88.40
Dry matter,	12.77	12.80	11.60
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	8.81	8.01	9.24
" cellulose,	11.04	10.96	11.60
" fat,	1.23	1.42	2.32
" protein (nitrogenous matter),	10.34	10.81	11.16
Non-nitrogenous extract matter,	68.58	68.80	65.68
	100.00	100.00	100.00

Fertilizing Ingredients in the Above Turnips.

	Per Cent.		
	VIII.	IX.	X.
Moisture at 100° C.,	87.23	87.20	88.40
Nitrogen,	.211	.221	.207
Phosphoric acid,	.136	.116	.125
Potassium oxide,	.546	.412	.452
Calcium oxide,	.106	.117	.080
Magnesium oxide,	.030	.033	.027
Sodium oxide,	.051	.133	.141
Ferric oxide,	.002	.009	.004
Insoluble matter,	.001	.072	.017
Valuation per 2,000 lbs.,	$1 32	$1 22	$1 21

The closing months of the summer season of 1887 were marked by an exceptional amount of rainfall. The serious influence of that circumstance showed itself in various direc-

tions in our vicinity. Some crops in low localities suffered more or less a premature decay, others did not reach their full maturity in due time. Our root crop, judging from the results of our examination, evidently did not reach its full perfection on account of the exceptional wetness of the latter part of the growing season. The moderate amount of dry vegetable matter found in the well-studied variety of Saxony sugar beet, as well as the large proportion of the nitrogen most of them contained in other combinations than in that of true albuminoid substances, entitle to that conclusion. Root crops are commonly reported to contain on an average from thirty-five to forty-five per cent. of their nitrogen in other and less valued combinations than the typical albuminous matter or the genuine protein substances. An examination of the subsequent tabular statement of some tests in that direction shows that our roots, as far as they have been submitted to an actual observation (1–7), contained from fifty-two to seventy per cent. of their nitrogen in various combinations quite generally considered of less nutritive value than the group of typical albuminous substances. The last-named class of compounds reaches usually its highest attainable proportions in a plant or part of a plant at the state of maturity.

Determination of Albuminoid Nitrogen in Roots raised upon the Fields of the Station.

	Per Cent.		
	Total Nitrogen.	Albuminoid Nitrogen.	Non-Albuminoid Nitrogen.
Root No. 1, ...	1.20	0.58	0.62
" 2, ...	1.61	0.55	1.06
" 3, ...	1.53	0.56	0.97
" 4, ...	1.90	0.57	1.33
" 5, ...	1.20	0.58	0.62
" 6, ...	1.81	0.51	1.30
" 7, ...	1.25	0.60	0.65

The various kinds of roots usually raised on farms for feeding purposes differ essentially in regard to the amount of dry vegetable matter they contain. Turnips contain from seven to eight per cent.; ordinary mangolds from eleven to twelve per cent.; improved varieties of beet roots, like Lane's, from fifteen to sixteen per cent.; good carrots from fourteen to fifteen per cent.; a good sugar beet from eighteen to twenty per cent. of solids; or, in other words, one ton of an improved variety of good sugar beets is equal to from two to two and one-half tons of ordinary turnips, as far as the amount of dry vegetable matter is concerned.

Modes of cultivation and of manuring exert a decided influence in this direction on the composition of the roots. Large roots of the same variety contain quite frequently less solid matter than the smaller ones. Close cultivation in the rows, in connection with the use of well-decomposed manurial matter as fertilizer, tends to produce good results.

The difference in the amount of solids, as far as each kind of root is concerned, is otherwise due, in the majority of cases, to a more or less perfect maturity. A liberal manuring with potash and nitrogen, in connection with a scanty supply of phosphoric acid, is frequently the cause of immatured roots at the ordinary harvest time.

2. *Field Observations with Root Crops in 1888.*

The field used for the work was of the same character as in the preceding trial. It represents a part of field "D" on our records, and is 328 feet long and 70 feet wide. The main field runs from east to west, and the rows run in all cases from south to north. The soil consists of a deep, sandy loam, and has been fertilized for several years annually with the same fertilizer, six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash per acre. Some of the land has been used before for the raising of root crops. It was ploughed in the autumn, 1887, and again on April 26, 1888. The fertilizer was applied April 30, in the customary way, broadcast, and slightly harrowed in before planting. The rows were seventy feet long and three feet three inches apart. The seed was taken partly from our own imported stock of previous years, and

partly chosen from varieties sent on by the United States Department of Agriculture at Washington, D. C. The following varieties were seeded May 17 and 19 : —

		Rows.
No. 1.	Excelsior Sugar Beet,	15
2.	Improved Imperial Sugar Beet,	6
3.	Vilmorin Sugar Beet,	14
4.	Lane's Sugar Beet,	9
5.	New Market Gardener Beet (red),	1
6.	Eclipse Beet (red),	1
7.	Osborn's Selected Beet (red),	1
8.	Yellow Danver's Carrot,	90

One row was planted with Saxony sugar beet, from our crop of 1887, for the purpose of raising seeds for our own consumption during the coming season.

The young plants appeared in all cases above ground May 28 ; they were in every instance, whenever necessary, thinned out to have them eight inches apart in the rows ; none were transplanted.

The average number of roots in a row was at the end of the season as follows : —

	Plants.
Excelsior Sugar Beet,	89
Improved Imperial Sugar Beet,	96
Vilmorin Sugar Beet,	119
Lane's Sugar Beet,	105
New Market Gardener Beet,	67
Eclipse Beet,	118
Osborn's Selected Beet,	122

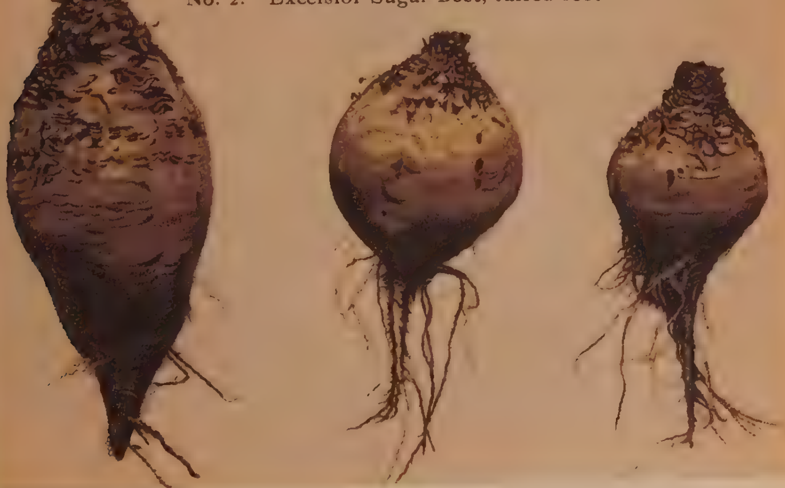
The entire yield of each of these varieties of beet roots without tops amounted to, —

1,870 pounds in fifteen rows of Excelsior.
1,070 pounds in six rows of Improved Imperial.
3,355 pounds in fourteen rows of Vilmorin.
1,250 pounds in nine rows of Lane's.
125 pounds in one row of New Market Gardener.
150 pounds in one row of Eclipse.
130 pounds in one row of Osborn's Selected.

The Vilmorin sugar beet exceeds in our case in yield all other sugar beets, allowing an equal number of rows with an equal number of plants. The yield per acre, with rows three feet and three inches apart, at our rate of production would amount to 22.95 tons.

No. 1. Saxony Sugar Beet, raised 1887.

No. 2. Excelsior Sugar Beet, raised 1888.



No. 3. Improved Imperial Sugar Beet, raised 1888.

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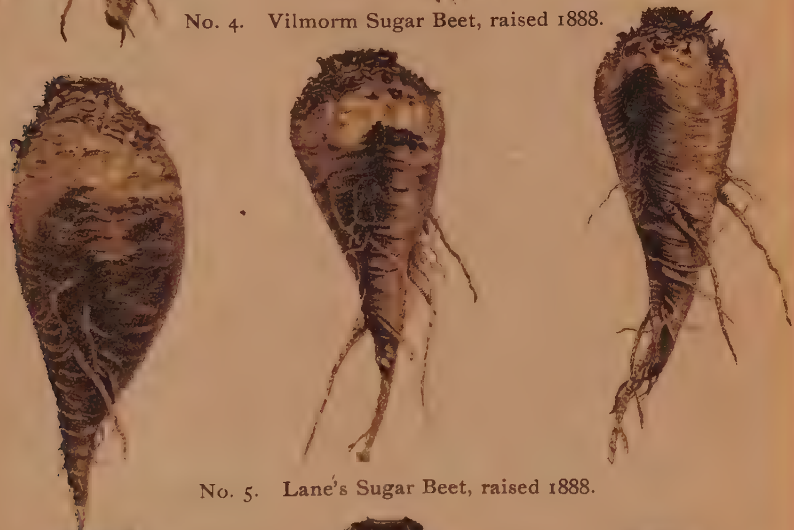
No. 4. Vilmorm Sugar Beet, raised 1888.



No. 5. Lane's Sugar Beet, raised 1888.

No. 6. New Market Gardener Beet, raised 1888.

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No. 7. Eclipse Beet (red), raised 1888.

No. 8. Osborn's Selected Beet (red), raised 1888.

No. 9. Danver's Carrot (yellow), raised 1888.

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The crop was harvested October 22. The entire season was remarkable for its exceptional coolness in July, and its abundance of rain. The leaves retained even to the time of harvesting a considerable degree of vitality.

Carrots (*Danver's Yellow*). — This crop occupied an area of 109 by 70 feet; the field was manured in the same way and with the same quantity of fine-ground bones and muriate of potash as the one which served for the raising of the above-mentioned varieties of roots. The soil was in both instances practically of a corresponding character, and in a corresponding state of fertilization. The seed was planted in rows, fourteen inches apart, June 1. The young plants appeared above ground June 17; the crop was kept clean from weeds by the use of the hand and the cultivator. The roots were harvested October 31; they amounted to 6,850 pounds, or 137 bushels, at 50 pounds each, which is equal to 19.52 tons per acre.

Samples of all the varieties of roots raised at the Station have been carefully collected and at once photographed, to present a concise idea of their peculiarity, as far as their exterior is concerned. Analyses of each kind will be presented later on. Three samples of every variety, representing the largest, middle and smallest size of each, served the photographer. The picture was in each case taken at a corresponding distance, to allow comparison of size. The weight of each is also stated.

TABULAR STATEMENT OF WEIGHTS OF ROOTS PHOTOGRAPHED.

		Largest.	Medium.	Smallest.
Picture No. 1.	Saxony Sugar Beet,* . . .	-	-	-
" 2.	Excelsior Sugar Beet, . . .	2 lbs. 14 oz.	1 lb 15 oz.	1 lb. 5 oz.
" 3.	Improved Imperial Sugar Beet, .	4 " 4 "	2 " 4 "	1 " 5 "
" 4.	Vilmorin Sugar Beet, . . .	5 " 0 "	2 " 7 "	1 " 2 "
" 5.	Lane's Sugar Beet, ...	2 " 15 "	1 " 9 "	1 " 7 "
" 6.	New Market Gardener Beet, . .	4 " 7 "	3 " 14 "	1 " 14 "
" 7.	Eclipse Beet, ...	2 " 11 "	1 " 13 "	0 " 12 "
" 8.	Osborn's Selected Beet, ...	2 " 11 "	1 " 9 "	1 " 2 "
" 9.	Danver's Carrot, ...	0 " 13 "	0 " 11 "	0 " 6 "

* Total weight of 3 sizes, 8 lbs. 12 oz.

VI. Notes on Miscellaneous Field Work.

Aside from the strictly experimental work on our older field, much preparatory work has been carried on during the past year on our more recent addition of lands. The older field, which has been for six years under our control, is located along the west side of the highway leading from Amherst to North Amherst; it covers an area of about twenty acres, including the grounds occupied by the present buildings of the Experiment Station. The more recent addition of lands (1886) is located along the east side of the highway; it covers an area of thirty acres, of which ten acres are occupied by a natural forest growth. The entire field forms the western slope of a prominent elevation. Most of the cultivated portion, which consisted of old grass lands, is gradually slanting towards the north-west, while a considerable portion of it is nearly on a level, with a slight depression towards the north. The entire area, consisting essentially of a good gravelly loam, admits of a satisfactory management of the work to be carried on upon it. The steeper portion along the wood land will be used for experiments with large and small fruits, the adjoining part towards the west for experiments with general farm crops, and the more level western termination for permanent grass lands. This plan for its future use was adopted after taking possession of the grounds in 1886.

As the lands along the slope are somewhat springy, and as its lower portion has at times to convey to the north a considerable amount of water coming from adjoining southern hillsides, a thorough system of underdraining was at once devised, and in its essential direction carried out, before any of the sod was turned over. Subsequently, during the autumn of 1886, the northern end of the entire field, to the extent of twelve acres, was ploughed; while the ploughing of the southern terminus of the field, comprising eight acres of old grass land, was for financial considerations reserved for a year later (1887).

The ploughed lands were thoroughly treated with a wheel harrow during the succeeding spring, before planting. Wood

ashes, at the rate of one ton per acre, was the only fertilizer used during the first season. This mode of manuring these lands was adopted for the purpose of assisting in a rapid decomposition of a rank growth, and of bringing the soil, as far as practicable, to a corresponding state of fertilization in the interest of future experiments. A variety of crops was subsequently planted, with the main aim to secure, in every instance, a thorough mechanical working of the soil by drill cultivation or by the use of the hoe. Several varieties of barley and of oats, corn, potatoes, squashes, and a variety of other garden crops, occupied the field. The periodical stirring of the soil promised to free the land from a foul growth, which in the course of time naturally overruns old grass lands.

During the month of September about seven acres of the entire cultivated area were prepared for a permanent meadow, and seeded down with a mixture of herd's grass and red-top; some varieties of clover were added the succeeding spring (1888).

The southern end of the field, which had still served, as above stated, for the production of hay, was turned over late in the season, to be prepared during the succeeding spring for future experiments in the same manner as the north end.

1888. — The preparatory work has been continued in all parts of this field. The exceptional rainfall has seriously tested the capacity of our drain tiles; they have stood the test, on the whole, satisfactorily. Needed alterations have been attended to, and the prospects are that no further serious trouble may be expected. No fertilizers but wood ashes have been used thus far. Drill cultivation has been generally adopted, to assist in future cultivation. Several acres of oats, barley and corn have been raised, to assist in the support of feeding experiments. The permanent grass lands have been increased here to from nine to ten acres. Definite grass mixtures have been used as seed, to test their respective merits in our locality. The results will be carefully watched, from a botanical as well as from an economical stand-point. An orchard will be laid out during the coming year.

The subsequent statement contains an enumeration of the principal crops raised in different parts of the farm, on lands either permanently assigned for the production of fodder for the live stock of the Station, or engaged in a course of preparation for future experiments : —

	Tons
Good English hay,	23
Rowen,	9
Corn stover,	3½
Corn fodder,	4½
Roots (carrots and sugar beets),	7
Oats (grain and straw),	4¼
Barley (grain and straw),	2
Green fodder (vetch, oats and cow-pea),	4½
Crops for ensilage (corn, 9½ tons; Soja bean, cow-pea and Hungarian grass, 3½ tons),	13
Potatoes (mainly Beauty of Hebron, Early Rose and Polaris), 260 bush.	

From four to five acres of Southern cow-pea, Soja bean, horse bean, lupine and buckwheat have been subjected to drill cultivation, for the purpose of renovating old grass lands and to serve ultimately as green manure.

NEW LAWS

FOR THE

REGULATION OF THE SALE OF COMMERCIAL FERTILIZERS.

WORK IN THE CHEMICAL DEPARTMENT.

I. FERTILIZER LAWS AND FERTILIZER ANALYSES.
II. MISCELLANEOUS ANALYSES.

The Legislature of 1888, at the suggestion of the State Board of Agriculture, has enacted a new law, entitled, "An Act to regulate the Sale of Commercial Fertilizers," chapter 296. This Act, which has been in operation since Sept. 1, 1888, assigns the supervision of the sale of commercial fertilizers to the director of the Massachusetts State Agricultural Experiment Station at Amherst, Mass.

The provisions of the Act are as follows: —

[Chap. 296.]

AN ACT TO REGULATE THE SALE OF COMMERCIAL FERTILIZERS.

Be it enacted, etc., as follows:

SECTION 1. Every lot or parcel of commercial fertilizer or material used for manurial purposes, sold, offered or exposed for sale within this Commonwealth, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement, clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water and reverted, as well as the total phosphoric acid. In the case of those fertilizers

which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients of the fertilizer it accompanies.

SECT. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold or offered for sale within the state of Massachusetts, shall file with the director of the Massachusetts agricultural experiment station, a certified copy of the statement named in section one of this act, and shall also deposit with said director at his request a sealed glass jar or bottle, containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

SECT. 3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, the retail price of which is ten dollars or more per ton, shall pay for each brand, on or before the first day of May annually, to the director of the Massachusetts agricultural experiment station, an analysis fee of five dollars for each of the three following fertilizing ingredients, namely, nitrogen, phosphorus and potassium, contained or claimed to exist in said brand or fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee named in this section; and on receipt of said analysis fees and statement specified in section two, the director of said station shall issue certificates of compliance with this act.

SECT. 4. No person shall sell, offer or expose for sale in the state of Massachusetts, any pulverized leather, raw, steamed, roasted, or in any form as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany or go with every parcel or lot of the same.

SECT. 5. Any person selling, or offering or exposing for sale, any commercial fertilizer without the statement required by the first section of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all the provisions of the foregoing section have not been fully complied with, shall forfeit fifty dollars for the first offence and one hundred dollars for each subsequent offence.

Sect. 6. This act shall not affect parties manufacturing, importing or purchasing fertilizers for their own use, and not to sell in this state.

Sect. 7. The director of the Massachusetts agricultural experiment station shall pay the analysis fees, as soon as received by him, into the treasury of the station, and shall cause one analysis or more of each fertilizer or material used for manurial purposes to be made annually, and publish the results monthly, with such additional information as circumstances advise: *provided*, such information relates only to the composition of the fertilizer or fertilizing material inspected. Said director is hereby authorized in person or by deputy to take a sample, not exceeding two pounds in weight, for analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in presence of said party or parties in interest or their representative, and taken from a number of packages which shall be not less than ten per cent. of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples, and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn, and the time and place of drawing; and said label shall also be signed by the director or his deputy and by the party or parties in interest or their representatives present at the drawing and sealing of said samples; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. All parties violating this act shall be prosecuted by the director of said station; but it shall be the duty of said director, upon ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material if the same shall be made substantially equivalent to the statement of analysis made by the manufacturer or importer.

Sect. 8. Sections eleven to sixteen inclusive of chapter sixty of the Public Statutes are hereby repealed.

Sect. 9. This act shall take effect on the first day of September in the year eighteen hundred and eighty-eight. [*Approved May 3, 1888.*

The above-stated regulations are now in force, and a compliance with them is imperative on all manufacturers, importers, agents or sellers of any brand of commercial fertilizer or of any material used for manurial purposes, the retail selling price of which is ten dollars or more per ton.

It will be noticed that the new provisions for the control of the trade in fertilizers in Massachusetts apply not only, as heretofore, to a certain class of more or less compound, distinct brands of commercial fertilizers, but to all materials, single or compound, used for manurial purposes, without regard to source, when offered for sale at ten dollars or more per ton.

The official report of analyses and of all materials used for manurial purposes, which are sold in this State under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted to a statement of chemical composition, and to such additional information as relates to the former. This change, it is expected, will tend to direct the attention of the consumer of fertilizers more towards the composition of the different brands of fertilizers offered for sale.

The practice of affixing to each analysis of this class of fertilizers an approximate commercial valuation per ton of their principal constituents has, therefore, been discontinued. Those who are not yet familiar with the current market value of fertilizing constituents may benefit by a short discussion of that subject at the close of this chapter.

The approximate market value of different brands of fertilizers, obtained by the current mode of valuation, does not express their respective agricultural value, *i.e.*, their crop-producing value. The higher or lower market price of different brands of fertilizer does not necessarily stand in a direct relation to their particular fitness, without any reference to the particular condition of the soil to be treated, and the special wants of the crop to be raised by their assistance. To select judiciously from among the various brands of fertilizers offered for patronage requires in the main two kinds of information; namely, we ought to feel confident that the particular brand of fertilizer in question contains the guaranteed quantities and qualities of essential articles of plant

food at a reasonable cost, and that it contains them in such form and in such proportions as will best meet existing circumstances and special wants. In some instances it may be mainly either phosphoric acid or nitrogen or potash; in others, two of them; and in others again, all three.

A remunerative use of commercial fertilizers can only be secured by attending carefully to the previously stated considerations.

The new duties assigned to the director of the Station render it necessary to discriminate in the future, in official publications of the results of analyses of commercial fertilizers and of manurial substances in general, between analyses of samples collected by a duly qualified delegate of the Experiment Station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties. In regard to the former alone can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

More detailed information in this connection, regarding the duties of the director of the Massachusetts State Agricultural Experiment Station, and the obligations of the manufacturers, dealers and agents engaged in the sale of commercial fertilizers or materials used for manurial purposes, may be obtained by addressing the director at Amherst, Mass. Copies of the above-printed Act may be had on application.

I.—Analyses of Commercial Fertilizers collected during the Past Season in the General Markets, by the Agent of the Massachusetts Agricultural Experiment Station.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
1	"Americus" Ammoniated Bone Superphosphate,	Williams & Clark Co., New York City, N. Y.,	Springfield.
2	"Americus" Potato Fertilizer,	" " " "	"
3	H. L. Phelps' Complete Manure; Guano and Potash,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
4	H. L. Phelps' Phosphate,	" " " "	"
5	H. L Phelps' Complete Manure for Corn and Grain,	" " " "	"
6	Bradley's XL Superphosphate of Lime,	Bradley Fertilizer Co., Boston, Mass.,	Northampton.
9	Crocker's Potato, Tobacco and Hop Phosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	"
10	Mapes' Corn Manure,	Mapes Formula and Peruvian Guano Co., New York City,	"
12	Mapes' Potato Manure,	" " " " "	"
14	Bowker's Hill and Drill Phosphate,	Bowker Fertilizer Co., Boston, Mass.,	Worcester.
15	Stockbridge's Manure for Vegetables,	" " " "	"
20	Randall's Combined Bone and Potash,	Benj. Randall, Boston, Mass.,	Boston.
23	Crocker's Ammoniated Bone Superphosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	Concord.
24	Standard Superphosphate,	Standard Fertilizer Co., Boston, Mass.,	Boston.
25	Allen Fertilizer,	American Manufacturing Co., Boston, Mass.,	"
26	Darling's Animal Fertilizer,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	"
60	Swan Island Guano,	. . . . .	Springfield.
61	Hargrave's Ground Bone,	Hargrave Manufacturing Co., Fall River, Mass.,	Amherst.
62	Cotton-seed Hull Ashes,	. . . . .	Whately.
63	Cotton-seed Hull Ashes,	. . . . .	South Deerfield.

TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1	"Americus" Ammoniated Bone Superphosphate,	14.87	2.91	2-3	9.63	0.61	0.41	10.65	11-13	10.24	10-12	2.54	2-3*
2	"Americus" Potato Fertilizer,	10.85	3.97	3-4	6.35	1.01	1.63	8.99	7-8	7.36	6-8	7.94	8-10*
3	H. L. Phelps' Complete Manure; Guano and Potash,	8.94	6.50	3.3-4.1	3.34	2.39	3.26	8.99	–	5.73	4-5	6.12	5-7
4	H. L. Phelps' Phosphate,	9.75	3.71	2.5-3.3	5.46	2.98	2.70	11.14	10-12	8.44	–	3.75	3-4
5	H. L. Phelps' Complete Manure for Corn and Grain,	9.74	4.07	4.1-5	5.83	1.64	4.47	11.94	8-10	7.47	6-8	7.19	7-8
6	Bradley's XL Superphosphate of Lime,	14.57	3.03	2.5-3.25	9.44	0.61	3.71	13.79	11-14	10.08	9-11	1.84	2-3*
9	Crocker's Potato, Tobacco and Hop Phosphate,	13.32	2.71	2-3	8.01	3.01	2.29	13.31	8-12	11.02	8-12	4.09	3.5-4.5*
10	Mapes' Corn Manure,	12.73	4.40	3.7-4.1	6.66	2.37	4.42	13.45	10-12	9.03	–	6.36	6-7
12	Mapes' Potato Manure,	9.98	4.08	3.7-4.4	4.22	3.53	6.18	13.93	8-10	7.75	6-8	6.72	6-8*
14	Bowker's Hill and Drill Phosphate,	13.06	3.27	2.5-3.25	7.84	2.98	2.31	13.13	11-14	10.82	10-12	2.25	2-3*
15	Stockbridge's Manure for Vegetables,	11.03	3.77	3.25-4.25	6.21	3.11	1.68	11.00	–	9.32	8-10	4.04	5-6
20	Randall's Combined Bone and Potash,	12.33	2.33	1.6-2.5	2.29	5.10	7.04	14.43	13-16	7.39	5-7	2.44	2-3
23	Crocker's Ammoniated Bone Superphosphate,	11.32	3.20	2.9-3.7	7.87	1.01	2.92	11.80	–	8.88	8-12	1.22	1-3*
24	Standard Superphosphate,	10.85	3.56	2.25-3.25	9.05	1.92	3.04	14.01	11-16	10.97	9-13	1.83	2-4
25	Allen Fertilizer,	21.14	2.50	2.0-3.1	5.45	2.47	1.79	9.71	6-10	7.92	5-8	5.19	4-6
26	Darling's Animal Fertilizer,	17.08	4.08	3.3-5	2.67	2.04	5.84	10.55	10-12	4.71	–	4.16	4-6
60	Swan Island Guano,	14.97	0.52	–	–	4.15	16.77	20.92	–	4.15	–	0.89	–
61	Hargrave's Ground Bone,	12.43	2.68	3.93	0.13	6.20	19.34	25.67	18.8	6.33	4-12	–	–
62	Cotton-seed Hull Ashes,	8.90	–	–	–	–	–	9.76	–	–	–	26.66	–
63	Cotton-seed Hull Ashes,	10.15	–	–	–	–	–	15.37	–	–	–	19.07	–

* Sulphate of potash, the source of potash.

TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
27	Standard Superphosphate,	Standard Fertilizer Co., Boston, Mass.,	Boston.
30	Soluble Pacific Guano,	Pacific Guano Co., Boston, Mass.,	Concord.
35	Darling's Lawn Dressing,	L B. Darling Fertilizing Co., Pawtucket, R. I.,	Boston.
36	Cumberland Superphosphate,	Cumberland Bone Co , Portland, Me.,	Fitchburg.
38	Chittenden's Complete Tobacco Fertilizer,	National Fertilizer Co., Bridgeport, Conn.,	North Hadley.
39	Chittenden's Complete Fertilizer for Potatoes,	" " " " "	South Deerfield.
40	Pequot Fish and Potash,	Quinnipiac Co., New London, Conn.,	"
42	Soluble Pacific Guano,	Glidden & Curtis, Boston, Mass.,	Plymouth.
45	Baker's A. A. Ammoniated Superphosphate,	H. J. Baker & Bro., New York City, N. Y.,	New Bedford.
49	Tucker's Imperial Bone Superphosphate,	J. A. Tucker & Co., Boston, Mass.,	Taunton.
52	Original Bay State Bone Superphosphate,	" " " "	W. Bridgewater.
53	Darling's Fine Ground Bone,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Cochesett.
54	Dow's Nitrogenous Superphosphate,	John C. Dow & Co., Boston, Mass.,	"
67	The Lawrence Fertilizer,	Lee, Blackburn & Co., Lawrence, Mass.,	Lawrence.
68	E. Frank Coe's High Grade Am. Bone Superphosphate,	E. Frank Coe, New York City, N. Y.,	Lowell.
74	Dole's 203 Fertilizer,	Dole Fertilizer Co., Boston, Mass.,	"
77	E. Frank Coe's Alkaline Bone,	E. Frank Coe, New York City, N. Y.,	"
85	Great Eastern General Fertilizer,	Great Eastern Fertilizer Co., Rutland, Vt.,	Pittsfield.
115	Bradley's Complete Manure for Potatoes and Vegetables,	Bradley Fertilizer Co., Boston, Mass.,	Mendon.
117	Brightman's Fish and Potash,	W. J. Brightman & Co., Tiverton, R. I.,	Swansea.

TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds. Found.	Nitrogen in 100 Pounds. Guaranteed.	Phosphoric Acid in 100 Pounds. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in 100 Pounds. Found.	Potassium Oxide in 100 Pounds. Guaranteed.
27	Standard Superphosphate,	14.86	3.41	2.25–3.25	8.60	2.09	2.94	13.63	11–16	10.69	9–13	2.96	2–4
30	Soluble Pacific Guano,	12 54	2.97	2.25–3	7.16	1.58	3.54	12.28	10.5–16	8.74	8.5–12	3.21	2–3.5
35	Darling's Lawn Dressing,	19.85	5.25	5–6.5	2.12	3.88	4.05	10 05	9–11	6.00	–	5.20	4–6
36	Cumberland Superphosphate,	14.55	2.89	2–4	6.17	2.95	3.58	12.70	12–14	9.12	9–13	2.57	2–3
38	Chittenden's Complete Tobacco Fertilizer,	9.45	3.07	3.3–5	3.87	5.28	3.45	12.60	8–10	9.15	6–8	4.26	*
39	Chittenden's Complete Fertilizer for Potatoes,	11.44	3.23	3.2–4.2	4.51	3 94	2.97	11.42	8–10	8.45	6–8	5.75	6–8
40	Pequot Fish and Potash,	23.25	3.40	2.5–3.3	0.35	3.37	2.11	5.83	–	3.72	3–5	4.22	4–6*
42	Soluble Pacific Guano,	14.20	3.00	2 25–3	7 87	1.11	1.77	10.75	10.5–12	8.98	8.5–12	2.29	2–3.5
45	Baker's A. A. Ammoniated Superphosphate,	19.32	3.40	1.7–3.2	10.40	1.23	0.14	11.77	–	11.63	10–12	3.18	2–3
49	Tucker's Imperial Bone Superphosphate,	21.29	2.45	2–2 5	5.98	1.73	2.70	10.41	9–10	7.71	7–8	2.98	*
52	Original Bay State Bone Superphosphate,	18.78	3.00	2.5–2 9	7.20	1.57	2.40	11.19	10–12	8.79	9–9.5	1.38	2–3
53	Darling's Fine Ground Bone,	5.79	2.95	3.5–4.5	–	7.42	17.31	24.73	22–25	7.42	–	–	–
54	Dow's Nitrogenous Superphosphate,	16.88	2.76	2.1–2.9	4.80	3.90	2.16	10.86	8–10	8.70	–	2.57	–
67	The Lawrence Fertilizer,	13.51	1.86	2.1–2.9	8.85	2.78	2.57	14.20	10–12	11.63	–	4.21	6
68	E. Frank Coe's High Grade Am. Bone Superphosphate,	9.42	2.62	2–2.5	8.37	1.51	2.17	12.05	11–13	9.88	9–12	2.34	*
74	Dole's 203 Fertilizer,	11.14	3.12	3–4	4.16	2.88	3.80	10.84	10–12	7.04	8–10	3.09	3–4
77	E Frank Coe's Alkaline Bone,	10.24	1.94	0.8–1.6	8.64	1.42	1.97	12.03	11–15	10.06	9–12	2.77	*
85	Great Eastern General Fertilizer,	12.35	2.95	2.9–3.7	5.37	3.31	2.58	11.26	9–15	8.68	8–12	2.01	2–4
115	Bradley's Complete Manure for Potatoes and Vegetables,	15.24	3.93	3.7–4.5	8.96	2.78	1.44	13.12	9–12	11.74	8–10	6.57	6–7
117	Brightman's Fish and Potash,	27.11	3.22	2.5–4.1	0.69	2.87	2.23	5.79	6.9	3.56	–	2.67	2–3

TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
8	Bradley's Dry Fish Guano,	Bradley Fertilizer Co., Boston, Mass.,	Northampton.
31	Americus Ammoniated Bone Superphosphate,	Williams & Clark Co., New York City, N. Y.,	Concord.
43	Bay State Fertilizer,	Clark Cove Guano Co., New Bedford, Mass.,	Plymouth.
64	Ames' Bone Fertilizer,	A. L. Ames, Peabody, Mass.,	Ipswich.
66	Common Sense Fertilizer,	Common Sense Fertilizer Co., Boston, Mass.,	Haverhill.
80	Lowell Bone Fertilizer,	Josiah M. Butman, Lowell, Mass.,	Chelmsford.
81	Jefferds' Animal Fertilizer,	John Jefferds, Worcester, Mass.,	Greenfield.
82	Crocker's Potato, Hop and Tobacco Phosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	"
87	Orient Complete Manure,	Orient Guano Manufacturing Co., Long Island, N. Y.,	Lee.
91	Adams' Market Bone Fertilizer,	Adams & Thomas, Springfield, Mass.,	Springfield.
95	E. Frank Coe's Potato Fertilizer,	E. Frank Coe, New York City, N. Y.,	Westfield.
118	Chittenden's Complete Tobacco Fertilizer,	National Fertilizer Co., Bridgeport, Conn.,	South Deerfield.
119	N. Ward's High Grade Animal Fertilizer,	N. Ward & Co., Boston, Mass.,	Boston.
120	Mayo's Superphosphate,	Mayo & Hix, Boston, Mass.,	Weston.
121	Whittemore Bros.' Fertilizer,	Whittemore Bros., Wayland, Mass.,	Wayland.
124	Economic Fertilizer, No. 3,	Economic Fertilizer Co., Boston, Mass.,	Charlestown.
127	Cleveland's Superphosphate,	Cleveland Dryer Co., Boston, Mass.,	Lowell.
128	Lister's Success Fertilizer,	Lister's Agricultural Chemical Works, Newark, N. J.,	"
17	Williams & Clark Co.'s Potato Phosphate,	Williams & Clark Co., New York City, N. Y.,	Worcester.
32	Bradley's X L Superphosphate,	Bradley Fertilizer Co., Boston, Mass.,	Westborough.
109	Pacific Guano Co.'s Fish and Potash,	Pacific Guano Co., Boston, Mass.,	South Amherst.
130	Cotton-seed Hull Ashes,	. . . .	Boston.

TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
8	Bradley's Dry Fish Guano,	7.25	8.83	8.2–9.9	0.41	2.91	3.05	6.37	6–8	3.32	–	–	–
31	Americus Ammoniated Bone Superphosphate,	15.09	3.26	2–3	9.07	1.52	–	10.59	11–16	10.59	10–12	2.71	2–3
43	Bay State Fertilizer,	12.07	3.22	2.1–2.8	8.24	0.98	1.50	10.72	9.5–14	9.22	9–11	2.51	2–3
64	Ames' Bone Fertilizer,	16.76	4.02	3.3–4.5	5.94	4.04	1.02	11.00	11–13	9.98	–	0.98	1
66	Common Sense Fertilizer,	11.14	1.74	2–4	0.03	7.16	2.53	9.72	9–14	7.19	–	1 83	1–2
80	Lowell Bone Fertilizer,	9.88	2.65	2–3	4.96	6.51	2.03	13.50	10–14	11.47	6–10	2.94	2–4
81	Jefferds' Animal Fertilizer,	5.39	3.88	4.1–5.8	0.18	6.15	11.19	17.52	14–16	6.33	–	6.04	5–7
82	Crocker's Potato, Hop and Tobacco Phosphate,	7.71	2.65	2–3	8.50	0.85	1.00	10.36	9–14	9.35	8–12	4.04	3.5-4.5*
87	Orient Complete Manure,	14.11	2.54	1.7–2.5	7.52	1.53	–	9.05	10–17	9.05	8–12	1.87	1-2.5*
91	Adams' Market Bone Fertilizer,	12.67	4.10	2.5–3.5	1.30	6.14	3.64	11.08	8–10	7.44	6–8	4.52	3–5
95	E. Frank Coe's Potato Fertilizer,	14.64	1.91	1.7–2.5	7.87	0.81	1.57	10 25	–	8.68	8–10	3.71	*
118	Chittenden's Complete Tobacco Fertilizer,	10.08	3.16	3.3–5	5.42	4.91	1.58	11.94	8–10	10.36	6–8	6.38	*
119	N. Ward's High Grade Animal Fertilizer,	14.43	3.69	2.88–3.7	5 69	5.37	1.41	12.47	–	11.06	12–14	3.89	4–5
120	Mayo's Superphosphate,	9.33	2.61	2.5–3	8.03	1.78	1.80	11.61	11.5–13.5	9 81	10.5–11.5	3.27	3–4
121	Whittemore Bros.' Fertilizer,	17.65	2.38	2.5–3.3	6 91	5.99	0.90	13.80	–	12.99	8–12	3.81	3–4
124	Economic Fertilizer, No. 3,	9.33	0.27	0.25–0.75	0.06	1.63	9.13	10.82	6–9	1.69	–	0.13	–
127	Cleveland Superphosphate,	7.73	2.71	2.05–2.55	7.74	3.19	3.18	14.11	10–13	10.93	8–10	2.14	3–4*
128	Lister's Success Fertilizer,	13.15	1.87	1.2–1.7	6.68	3.17	2.57	12.42	–	9 87	10.5–12	1.50	1.5–2*
17	Williams & Clark Co.'s Potato Phosphate,	14.46	3.03	2–3	7.24	2.30	5.94	15.48	8–10	9.54	7–10	5.61	6–8*
32	Bradley's XL Superphosphate,	15.78	3 07	2.5-3 25	7.26	2.87	2.12	12.25	11–14	10.13	9–11	1.99	2–3*
109	Pacific Guano Co.'s Fish and Potash,	13.90	2 65	2.5–3.3	3.44	3.05	3.12	9.61	6–9	6.49	4–7	5.28	4–6
130	Cotton-seed Hull Ashes,†	6.51	–	–	–	–	–	3.11	–	–	–	17.37	–

* Sulphate of potash, the source of potash. † Insoluble matter, 39.29 per cent., exceptionally large.

TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
21	Randall's Market Garden Fertilizer,	Benjamin Randall, Boston, Mass.,	Boston.
22	Stockbridge's Manure for Strawberries,	Bowker Fertilizer Co., Boston, Mass.,	Concord.
34	Breck's Lawn and Garden Dressing,	Standard Fertilizer Co., Boston, Mass.,	Boston.
69	Darling's Pure Dissolved Bone Superphosphate,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Ipswich.
71	The Allen Fertilizer for Corn,	American Manufacturing Co., Boston, Mass.,	Reading.
86	E. Frank Coe's High Grade Fish Guano and Potash,	E. Frank Coe, New York City, N. Y.,	Westfield.
94	Great Eastern Vegetable, Vine and Tobacco Fertilizer,	Great Eastern Fertilizer Co., Rutland, Vt.,	Pittsfield.
99	H. Preston & Son's Ammoniated Bone Superphosphate,	H. Preston & Son, Greenpoint, Long Island,	"
104	Quinnipiac Phosphate,	Quinnipiac Fertilizer Co., New London, Conn.,	Williamstown.
107	Pacific Guano Co.'s Fish and Potash,	Glidden & Curtis, Boston, Mass.,	"
108	Geo. W. Miles' IXL Ammoniated Bone Superphosphate,	Geo. W. Miles, Milford, Conn.,	Amherst.
122	Bartlett's Bone,	C. A. Bartlett, Worcester, Mass.,	Worcester.
129	Lister's Celebrated Bone,	Lister's Agricultural Chemical Works, Newark, N. J.,	Lowell.
131	Church's Fish and Potash,	Jos. Church & Co., Tiverton, R. I.,	Somerset.

TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.
21	Randall's Market Garden Fertilizer,	14.52	3.83	2.9–3.3	4 61	3.24	2.25	10.10	–	7.85	8.5–11	4.12	4–5
22	Stockbridge's Manure for Strawberries,	10.90	3 38	2.88–3.7	4 16	2.96	4.55	11.67	7–9	7.12	6–7	3.29	4–5
34	Breck's Lawn and Garden Dressing,	8.68	5.42	4.1–5	6.54	1.94	1.34	9.82	–	8.48	8–9	4 67	4–6
69	Darling's Pure Dissolved Bone Superphosphate,	11.01	2.40	2.06–2.47	6.12	10.45	1.16	17.73	16–18	16.57	15–17	–	–
71	The Allen Fertilizer for Corn,	20.77	2.42	2.06–3.09	4.54	1.72	1.44	7.70	6–10	6.26	5–8	2.91	4–6
86	E. Frank Coe's High Grade Fish Guano and Potash,	12.07	2.66	3.3–4.1	2.08	2.36	5.25	9.69	–	4.44	6–8	3.26	*
94	Great Eastern Vegetable, Vine and Tobacco Fertilizer,	12.07	2.95	2.06–2.88	6.05	2.42	2.09	10.57	9–15	8.47	8–12	5.98	6–8
99	H. Preston & Son's Ammoniated Bone Superphosphate,	15.12	2.50	2.47–3 3	5.04	2.24	3.42	10.70	–	7.28	9–10	1.86	2–3
104	Quinnipiac Phosphate,	15.69	3.23	2.75–3.25	8.11	2.20	1.11	11.24	–	10.31	9–12	2.34	2–3*
107	Pacific Guano Co.'s Fish and Potash,	11.78	3.47	2.47–3.3	4.27	1.94	2.64	8.85	6–9	6.21	4–7	6.55	4–6
108	Geo. W. Miles' IXL Ammoniated Bone Superphosphate,	19.18	2.27	2.06–3.3	7.75	1.69	1.10	10.54	–	9.44	8–12	2.20	1–3
122	Bartlett's Bone,	4.41	2.28	–	0.25	15.78	13.79	29 82	–	16.03	–	–	–
129	Lister's Celebrated Bone,	10.62	3.51	2.7–2.9	0.51	9.29	3.13	12.93	12–14	9.80	–	–	–
131	Church's Fish and Potash,	26 55	3.62	3.71–4.12	1.62	2.32	0.79	4.91	5–6	3.94	–	4.28	3.5–4*

* Sulphate of potash, the source of potash.

TABLE I. — *Continued.*

LABORATORY No.	NAME OF BRAND.	NAME OF MANUFACTURER.	SAMPLED AT.
16	Stockbridge's Manure for Seeding Down,	Bowker Fertilizer Co., Boston, Mass.,	Worcester.
28	Stockbridge's Manure for Grass, Top Dressing and Forage Crops,	" " " "	Ware.
29	Stockbridge's Manure for Potatoes,	" " " "	"
37	Seeding Down Fertilizer,	Cumberland Bone Co., Portland, Me.,	Fitchburg.
41	Quinnipiac Dry Ground Fish,	Quinnipiac Fertilizer Co., New London, Conn.,	South Deerfield.
46	Baker's Complete Grass Manure,	H. J. Baker & Bro., New York City,	New Bedford.
47	Baker's Special Corn Fertilizer,	" " "	"
51	Darling's Animal Fertilizer,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Cochesett.
55	Brightman's Dry Ground Fish Guano,	W. J. Brightman & Co., Tiverton, R. I.,	"
56	Brightman's Fish and Potash,	" " " "	"
58	Dow's Grass Fertilizer,	John C. Dow & Co , Boston, Mass.,	"
65	Farmers' New Method Fertilizer,	Bradley Fertilizer Co., Boston, Mass.,	Newburyport.
70	The Lawrence Fertilizer,	Lee, Blackburn & Co., Lawrence, Mass.,	Lawrence.
76	The Lawrence Fertilizer,	" " " "	"
83	Jefferds' Fine Ground Bone,	John Jefferds, Worcester, Mass.,	Greenfield.
84	Adams' Market Bone Fertilizer for Potatoes.	Adams & Thomas, Springfield, Mass.,	Springfield.
88	Church's Fish and Potash,	Jos. Church & Co., Tiverton, R. I.,	"
123	Economic No. 1,	Economic Fertilizer Co., Boston, Mass.,	Charlestown.

TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds. Found.	Nitrogen in 100 Pounds. Guaranteed.	Phosphoric Acid in 100 Pounds. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in 100 Pounds. Found.	Potassium Oxide in 100 Pounds. Guaranteed.
16	Stockbridge's Manure for Seeding Down,	12.81	3.20	2.5–3.3	4.22	2.91	6.40	13.53	–	7.13	14–15	3.22	4–5
28	Stockbridge's Manure for Grass, Top Dressing and Forage Crops,	15.23	5.28	5.5–6.5	3.94	1.67	4.61	10.22	6–8	5.61	5–6	2.85	2.5–3.5
29	Stockbridge's Manure for Potatoes,	10.38	3.98	3.25–4.25	5.90	2.23	2.59	10.72	9–11	8.13	7–9	4.82	5–6
37	Seeding Down Fertilizer,	16.27	1.89	1.60	1.55	5.91	16.14	23.60	18–20	7.46	5–9	0.26	1
41	Quinnipiac Dry Ground Fish,	7.63	7.94	7.5–10	0.50	2.31	3.77	6.58	–	2.81	4–6	–	–
46	Baker's Complete Grass Manure,	18.50	4.34	3.71	5.28	0.62	–	5.90	–	5.90	5	7.68	7.5
47	Baker's Special Corn Fertilizer,	10.47	5.81	4.12	1.65	5.23	0.10	6.98	7.25–9.25	6.88	6.25	6.55	7
51	Darling's Animal Fertilizer,	15.07	3.48	3.3–4.94	2.70	4.90	2.92	10.52	10–12	7.60	–	4.95	4–6
55	Brightman's Dry Ground Fish Guano,	14.02	7.18	8.24–9.89	0.38	2.30	6.22	8.90	6.8–9.16	2.68	–	–	–
56	Brightman's Fish and Potash,	23.59	2.90	2.5–4.1	1.48	2.21	1.08	4.77	6.8–8.2	3.69	2–3	3.35	2–3
58	Dow's Grass Fertilizer,	12.48	3.50	3.3–4.12	0.72	2.75	7.52	10.99	12–14	3.47	–	3.04	2–3
65	Farmers' New Method Fertilizer,	14.90	1.32	0.82–1.82	8.60	0.93	1.06	10.59	10–12	9.53	8–10	1.50	*
70	The Lawrence Fertilizer,	13.29	1.73	2.06–2.88	8.28	2.38	2.97	13.63	10–12	10.66	–	4.86	10
76	The Lawrence Fertilizer,	12.62	1.67	2.06–2.88	9.60	2.66	2.94	15.20	10–12	12.26	–	0.58	2–3
83	Jefferds' Fine Ground Bone,	9.03	1.86	2.47–3.3	0.13	7.73	21.68	29.54	27–30	7.86	–	–	–
84	Adams' Market Bone Fertilizer,	9.58	3.95	2.5–3.5	1.38	4.34	5.47	11.19	8–10	5.72	6–8	5.30	3–5
88	Church's Fish and Potash,	26.48	2.48	3.71–4.12	1.91	2.74	0.35	5.00	5–6	4.65	–	4.22	3.5–4*
123	Economic No. 1,	11.68	1.71	1–2	–	0.61	4.22	4.83	2–4	0.61	–	0.19	–

* Sulphate of potash, the source of potash.

TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
7	Bone and Potash (Circle Brand),	Bradley Fertilizer Co., Boston, Mass.,	Springfield.
33	Randall's Farm and Field,	Benj. Randall, Boston, Mass.,	Boston.
59	Dow's Ground Bone,	J. C. Dow & Co., Boston, Mass.,	Cochesett.
75	Unicorn Brand Ammoniated Superphosphate,	Clark's Cove Guano Co., New Bedford, Mass.,	Ipswich.
78	Bradley's Sea Fowl Guano,	Bradley Fertilizer Co., Boston, Mass.,	"
89	World of Good Tobacco Grower,	Thomson & Edwards Fertilizer Co., Chicago, Ill.,	North Hatfield.
90	Original Coe's Superphosphate of Lime,	Bradley Fertilizer Co., Boston, Mass.,	Shelburne Falls.
92	Chittenden's Ammoniated Bone Superphosphate,	National Fertilizer Co., Bridgeport, Conn.,	Pittsfield.
93	Great Eastern General Fertilizer,	Great Eastern Fertilizer Co., Rutland, Vt.,	Glendale.
100	Chittenden's Universal Phosphate,	National Fertilizer Co., Bridgeport, Conn.,	Pittsfield.
101, 105, 112	Soluble Pacific Guano,	Glidden & Curtis, Agents, Boston, Mass.,	Williamstown.
102	Williams & Clark Co.'s Ammoniated Bone Superphosphate (Americus Brand),	Williams & Clark Co., New York,	Great Barrington.
103	E. Frank Coe's High Grade Ammoniated Superphosphate,	E. Frank Coe, New York,	North Adams.
110	Geo. W. Miles' Fish and Potash Manure,	Geo. W. Miles, Milford, Conn.,	Amherst.
125	Economic No. 4, for Potatoes,	Economic Fertilizer Co., Boston, Mass.,	Charlestown.
132	Darling's Fine Ground Bone,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	
134	Cotton-seed Hull Ashes,	. . . .	Granby.

TABLE I. — *Concluded.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds. Found.	Nitrogen in 100 Pounds. Guaranteed.	Phosphoric Acid in 100 Pounds. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in 100 Pounds. Found.	Potassium Oxide in 100 Pounds. Guaranteed.
7	Circle Brand of Bone and Potash,	8.04	2.05	1.9-2.6	2.98	4.08	6.55	13.61	8-12	7.06	–	1.72	2-3
33	Randall's Farm and Field,	19.34	2.50	1.6-2.7	4.99	2.65	1.57	9.21	10-16	7.64	8-11	2.20	2-4
59	Dow's Ground Bone,	9.11	2.76	2.06-2.47	0.67	3.20	13.97	17.84	18-22	3.87	–	1.95	3-4
75	Unicorn Brand Ammoniated Superphosphate,	12.91	2.37	1.8-2.5	4.67	2.05	3.79	12.51	10-13	8.72	8.5-10	3.40	2.25-3
78	Bradley's Sea Fowl Guano,	16.55	2.41	2.5-3.25	8.25	2.70	2.03	12.98	11-14	10.95	9-11	1.90	2-3*
89	World of Good Tobacco Grower,	6.81	1.66	3.30-4.11	5.85	1.57	4.73	12.15	10-12	7.42	–	1.35	*
90	Original Coe's Superphosphate of Lime,	14.82	3.36	2.05-2.25	7.28	2.96	1.25	11.49	10-13	10.24	8-10	1.18	1-2*
92	Chittenden's Ammoniated Bone Superphosphate,	13.81	2.41	1.5-2.47	5.44	2.43	5.18	13.05	9-11	7.87	7-9	2.78	2-4
93	Great Eastern General Fertilizer,	13.09	3.74	2.88-3.71	5.22	3.50	2.81	11.53	9-15	8.72	8-12	1.87	2-4
100	Chittenden's Universal Phosphate,	8.48	2.73	2.06-2.88	2.21	4.99	8.54	15.74	11-12	7.20	9-11	3.20	2-3
101, 105, 112	Soluble Pacific Guano,	11.51	3.23	2.25-3	6.26	2.89	2.67	11.82	10.5-16	9.15	8.5-12	1.97	2-3.5
102	Williams & Clark Co.'s Ammoniated Bone Superphosphate (Americus Brand),	13.57	3.22	2-3	6.78	2.97	0.49	10.24	11-16	9.75	8-9	3.78	2-3*
103	E. Frank Coe's High Grade Ammoniated Superphosphate,	10.72	2.52	2-2.5	7.80	1.27	2.83	11.90	11-13	9.07	9-12	2.16	*
110	Geo. W. Miles' Fish and Potash Manure,	13.45	3.02	2.47-4.12	5.37	2.91	1.31	9.59	7-10	8.28	6-7	4.46	3-5
125	Economic No. 4, for Potatoes,	12.15	0.69	0.25-0.75	0.25	0.84	5.28	6.37	2-4.5	1.09	–	0.56	–
132	Darling's Fine Ground Bone,	8.12	3.60	3.5-4.5	0.17	9.12	14.75	24.13	22-25	9.29	–	–	–
134	Cotton-seed Hull Ashes,	13.50	–	–	–	–	–	8.83	–	–	–	20.97	–

* Sulphate of potash, the source of potash.

II.—Analysis of Commercial Fertilizers and Manurial Substances sent on for Examination.

Wood Ashes.

[I. Sent on from Ipswich, Mass. II. and III. Sent on from Concord, Mass]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	4.24	14.50	14.13
Calcium oxide,	38.30	33.34	33.45
Magnesium oxide,	2.82	3.83	3.39
Potassium oxide,	2 55	5.76	6.32
Phosphoric acid,	1.83	1.28	1.40
Insoluble matter (before calcination),	21.58	14.96	14.83
Insoluble matter (after calcination),	19.81	9.95	11.67

Sample I. contains but one-half the amount of potash of an ordinary quality of Canada wood ash. Samples II. and III. are of a good quality, and correspond fairly with the guaranty of the dealer. The question has been repeatedly asked, on what basis to adjust differences between a stated guaranty of composition and the actual results of an analysis of a sample of wood ash. Our answer has been, in these cases, to allow 5½ cents for every pound of potassium oxide and 6 cents for every pound of phosphoric acid which the analysis shows to be less than the guaranty states to be present.

Wood Ashes.

[I. Sent on from Amherst, Mass. II. Sent on from Amherst, Mass. III. Sent on by F. H. Greeley, Salisbury, Mass. IV. Sent on by J. D. W. French, North Andover, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.67	19.14	7.29	17.14
Phosphoric acid,	1.25	1.72	3.09	5.04
Calcium oxide,	39.06	30.16	45.22	35.59
Potassium oxide,	5.38	4.76	4.37	4.22
Magnesium oxide,	2.88	3.04	4.27	6.45
Insoluble matter (before calcination),	17.42	21.72	18.14	17.47
Insoluble matter (after calcination),	8.79	13.45	11.23	12.19

[V. Sent on by C. F. Clark, Boston, Mass. VI. Sent on by Coolidge Bros., South Sudbury, Mass. VII. and VIII. Sent on by Fred L. Ames, Boston, Mass.]

	Per Cent.			
	V.	VI.	VII.	VIII.
Moisture at 100° C.,	4.94	4.41	12.33	8.20
Phosphoric acid,	1.54	1.28	1.54	1.87
Calcium oxide,	31.70	35.50	34.17	40.15
Potassium oxide,	4.80	4.76	4.39	4.70
Magnesium oxide,	4.58	4.87	3.26	4.42
Insoluble matter (before calcination),	20.85	9.64	15.37	20.55
Insoluble matter (after calcination),	18.57	6.10	12.19	18.33

Wood Ashes.

[I. Sent on by F. H. Williams, Sunderland, Mass. II. Sent on by C. H. Thompson & Co., Boston, Mass. III. and IV. Sent on from Amherst, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.31	2.57	8.67	19.14
Phosphoric acid,	1.65	1.53	1.25	1.72
Magnesium oxide,	2.41	5.29	2.88	3.04
Calcium oxide,	37.39	26.94	39.06	30.16
Potassium oxide,	7.78	7.95	5.38	4.76
Insoluble matter (before calcination),	10.93	17.44	17.42	21.76
Insoluble matter (after calcination),	6.15	15.66	8.79	13.45

Wood Ashes.

[I. Sent on by S. M. Farnsworth, Harvard, Mass. II. Sent on by J. J. H. Gregory, Marblehead, Mass. III. Sent on by D. G. Lang, Concord, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	16.51	2.76	22.07
Phosphoric acid,	1.37	3.09	0.48
Magnesium oxide,	4.03	2.84	3.48
Calcium oxide,	32.54	32.03	29.11
Potassium oxide,	5.07	10 24	5.84
Insoluble matter (before calcination),	16.13	24.39	19.70
Insoluble matter (after calcination),	13.06	17.91	15.13

Cotton-seed Hull Ashes.

[I. Sent on from Hatfield, Mass. II. Sent on from Agawam, Mass. III. Sent on from South Deerfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	13.26	7.15	10.19
Phosphoric acid (6 cts. per lb.),	8.83	8.06	15.37
Potassium oxide (5½ cts. per lb.),	24.13	28.22	19.07
Calcium oxide,	8.92	10.50	5.14
Magnesium oxide,	8.60	15.25	9.78
Insoluble matter (before calcination),	14.29	12.75	18.11
Insoluble matter (after calcination),	12.22	10.57	12.16
Valuation per 2,000 lbs,	$37.14	$40.71	$39.42

The samples are of an exceptionally good quality.

Cotton-seed Hull Ashes.

[Sent on by Benj. M. Warner, Hatfield, Mass.]

	Per cent.
Moisture at 100° C.,	6.95
Phosphoric acid,	3.14
Potassium oxide,	25.10
Calcium oxide,	12.41
Magnesium oxide,	5.84
Insoluble matter (before calcination),	55.48
Insoluble matter (after calcination),	9.58

Potash Fertilizers.

[I. Muriate of Potash. II. Sulphate of Potash and Magnesia, sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	2.21	8.08
Potassium oxide,	49.77	21.88
Sodium oxide,	10.06	5.06
Calcium oxide,	2.07	3.54
Magnesium oxide,	0.45	11.93
Sulphuric acid,	0.55	43.43
Chlorine,	50.00	3.10
Insoluble matter,	0.17	0.77

Saltpetre Waste from Gunpowder Works.

[Sent on from Acton, Mass.]

	Per cent.
Moisture at 100° C.,	5.19
Potassium oxide,	15.04
Sodium oxide,	36.82
Total calcium oxide,	.47
Total magnesium oxide,	.27
Nitrogen,	1.90
Sulphuric acid,	1.02
Total chlorine,	53.50
Calcium chloride,	.05
Magnesium chloride,	.63
Insoluble matter,	Trace.

The composition of this material varies in different samples in a marked degree. Its application on forage crops and on grass lands in particular has proved highly satisfactory.

Muck.

[I. and II. Sent on from Marlborough, Mass. III. Sent on from Concord, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	33.64	40.63	56.46
Dry matter,	66.36	59.37	43.54
Nitrogen in dry matter,	1.65	1.21	1.16
Ash constituents in dry matter,	6.44	18.73	4.72
Insoluble matter in ash,	5.76	15.07	Not determined.

These samples are fair representatives of their kind. As the agricultural value of this material has been repeatedly discussed in previous reports, no further statement seems to be called for.

Muck.

[I. and II. Sent on by A. A. Rice, Mount Hermon, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	30.26	75.44
Dry matter,	69.74	24.56
Nitrogen,	2.54	.37
Ash constituents in dry matter,	8.28	12.00

Muck.

[Sent on by W. H. Earle, Worcester, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.030	11.231
Ash,	51.289	51.400
Ferric oxide,	Trace.	Trace.
Aluminic oxide,	6.672	6.953
Calcium oxide,	.038	.049
Magnesium oxide,	.030	.031
Potassium oxide,	.051	.062
Phosphoric acid,	.198	.232
Nitrogen,	1.470	1.460
Insoluble silicious matter,	39.755	39.635

Sea-weed.

[Sent on from Eastham, Mass., — two samples.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	12.05	14.96
Nitrogen (16½ cts. per lb.),	1.66	1.28
Phosphoric acid (6 cts. per lb.),	.44	.17
Potassium oxide (4¼ cts. per lb.),	3.81	.36
Calcium oxide,	2.73	3.86
Magnesium oxide,	1.48	1.30
Sodium oxide,	11.75	8.40
Chlorine,	6.40	5.28
Insoluble matter,	7.73	.78
Valuation per 2,000 lbs.,	$9.25	$4.72

The samples were received in an air-dry state. According to statement, I. had been dried without any serious exposure to bad weather; II. had suffered from exposure for a considerable length of time.

Cotton-seed Meal (for manurial purposes).

[I. Sent on by Geo. Frost, Boston, Mass. II. and III. Sent on by C. L. Warner, Hatfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	6.26	8.30	8.30
Ash,	6.16	5.77	5.77
Calcium oxide,	.31	.31	.31
Magnesium oxide,	.95	.77	.77
Potassium oxide,	1.80	1.21	.89
Phosphoric acid,	1.32	1.45	1.26
Nitrogen,	7.26	6.60	6.88
Insoluble matter,	.53	.40	.40

Refuse Camel's Hair from Cotton-seed Oil Works.

[Sent on by W. H. Bowker, Boston, Mass.]

	Per cent.
Moisture at 100° C.,	8.80
Ash,	7.25
Nitrogen,	5.92
Potassium oxide,	2.56
Phosphoric acid,	2.77
Insoluble matter,	1.27

Castor Pomace.

[Sent on by Benj. M. Warner, Hatfield, Mass.]

	Per cent.
Moisture at 100° C.,	8.67
Ash,	5.70
Nitrogen,	5.72
Phosphoric acid,	1.57
Potassium oxide,	.97
Calcium oxide,	.71
Magnesium oxide,	.65
Insoluble matter,	1.21

Cotton Waste.

[Sent on by Samuel Pillsbury, Boston, Mass.]

	Per cent.
Moisture at 100° C.,	8.24
Nitrogen,	2.09
Phosphoric acid,	.83
Calcium oxide,	2.52
Magnesium oxide,	.66
Potassium oxide,	1.62
Insoluble matter,	20.10

Wool Waste.

[Sent on by A. S. Shepard, Franklin, Mass.]

	Per cent.
Moisture at 100° C.,	7.67
Ash,	10 63
Phosphoric acid,	1.15
Potassium oxide,	.54
Nitrogen,	5.26
Insoluble matter,	5.83

Waste from Cotton-seed Presses.

[Sent on by Oliver R. Robbins, Weston, Mass.]

	Per cent.
Moisture at 100° C.,	6.83
Ash,	23.47
Phosphoric acid,	.96
Potassium oxide,	.20
Nitrogen,	4.24
Insoluble matter,	17.74

Waste from Linseed Presses.

[Sent on by Oliver R. Robbins, Weston, Mass.]

	Per cent.
Moisture at 100° C.,	7.06
Ash,	2.34
Phosphoric acid,	2.43
Potassium oxide,	.24
Nitrogen,	8.05
Insoluble matter,	1.00

Scouring Liquor of Raw Wool.

[Sent on from Plymouth, Mass.]

	Per cent.
Moisture at 100° C.,	92.03
Dry matter,	7.97
Nitrogen (in liquid),	.09
Ash,	3.28
Calcium oxide,	.04
Magnesium oxide,	Trace.
Potassium oxide,	1.09
Sodium oxide,	.92
Iron and alumina oxides,	.09
Insoluble matter,	.22

One hundred parts of ash contained, —

	Per cent.
Calcium oxide,	1.22
Magnesium oxide,	Trace.
Potassium oxide,	33.23
Sodium oxide,	28.05
Iron and alumina oxides,	2.74
Insoluble matter,	6.91

The above-stated liquid was obtained, according to information received, by scouring raw wool with a solution of soda-ash and soap. The most noticeable constituent of the material is its comparatively large amount of potash (1.09 per cent.) in the calcined residue or ash. The presence of a liberal amount of potash compounds in raw wool is well known. A sample of raw wool from South America, tested here in that direction some years ago, showed from 3.92 to 4.2 per cent. of potassium oxide. The washings of sheep and of raw wool may be used with a good effect on grass lands. Solutions like the one above described are, however, too concentrated for direct use; they ought to be diluted with from ten to twenty times their weight of water, to render advisable their direct application on any growing vegetation.

Refuse Material from Soap Works.

[Sent on by Holyoke Soap Works, Holyoke, Mass.]

	Per cent.
Moisture at 100° C.,	19.70
Total phosphoric acid,	15.37
Soluble phosphoric acid,	.03
Reverted phosphoric acid,	5 29
Insoluble phosphoric acid,	10.05
Nitrogen,	4.24
Insoluble matter,	1.37

This material is similar to tankage in composition and in mechanical condition.

Fish Fertilizers.

[Sent on from Eastham, Mass. I. Salt Fish Waste. II. Fish Chum. III. Salt Fish Trimmings. IV. Whalebone. V. Whale Scrap.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C., . . .	37.35	53.86	5.22	6.81	9.51
Total phosphoric acid, . .	2.89	3.80	5.50	20.84	1.15
Soluble phosphoric acid (8 cts. per lb.), ...	.58	.36	.69	.31	.84
Reverted phosphoric acid (7½ cts. per lb.), ...	1.16	1.77	2.15	1.84	.07
Insoluble phosphoric acid (3 cts. per lb.), ...	1.15	1.67	2 66	18.69	.24
Nitrogen (12 cts. per lb.), .	5.26	4.26	7.63	3.40	9.64
Insoluble matter, . . .	.10	.06	.26	3.69	9.10
Valuation per 2,000 lbs., . .	$15.96	$14.46	$24.24	$22.67	$24 73

The main quantity of these substances was in a very coarse state.

Dry Ground Fish.

[I. and II. Sent on by R. P. Smith, Hatfield, Mass. III. Sent on by W. W. Sanderson, South Deerfield, Mass.]

	PER CENT.		
	I.	II.	III.
Moisture at 100° C., ...	8.34	9.92	10.10
Ash, ...	37.76	28.37	21.50
Total phosphoric acid, ...	8.23	7.96	6.67
Soluble phosphoric acid, ...	.10	.61	.32
Reverted phosphoric acid, ...	3.81	3.79	.75
Insoluble phosphoric acid, ...	4.32	3.56	5.60
Nitrogen, ...	6.81	6.82	6.98
Insoluble matter, ...	82	1.34	4.57

Peruvian Guano.

[From P. Williams & Co., Taunton, Mass. I. Warranted Peruvian Guano, No. 1. II. Low-grade Peruvian Guano.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	14.18	16.14
Ash,	47.36	65.01
Total phosphoric acid,	19.91	22.26
Soluble phosphoric acid,	7.34	2.24
Reverted phosphoric acid,	6.05	5.03
Insoluble phosphoric acid,	6.52	14.99
Potassium oxide,	2.80	4.17
Nitrogen,	8.01	4.06
Insoluble matter,	4.04	7.83

Phosphatic Fertilizers.

[Sent on from Ashby, Mass. I. Acid Phosphate. II. Dissolved Bone-black. III. South Carolina Rock Phosphate.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	13.93	13.86	1.68
Total phosphoric acid,	13.84	16.37	25.81
Soluble phosphoric acid (8 cts. per lb.),	10.91	14.60	.27
Reverted phosphoric acid (7½ cts. per lb.),	.69	1.53	.47
Insoluble phosphoric acid (2 cts. per lb.),	2.24	.24	25.07
Insoluble matter,	9.54	2.09	11.64
Valuation per 2,000 lbs.,	$19.38	$25 80	$11.16

Bone-black.

[Sent on by F. G. Arnold, Swansea, Mass.]

	Per cent.
Moisture at 100° C.,	5.04
Ash,	67.43
Phosphoric acid,	16.56
Insoluble matter,	.37

Ground Bones.

[I., II. and III. Sent on from Amherst, Mass. IV. Sent on from Jamaica Plain, Mass.]

Mechanical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Fine, smaller than $\frac{1}{50}$ inch, . . .	63.29	40.44	56.69	37.48
Fine medium, smaller than $\frac{1}{25}$ inch, .	27.78	30.91	34.97	35.51
Medium, smaller than $\frac{1}{12}$ inch, . .	8.93	25.30	8.34	18.91
Coarser than $\frac{1}{12}$ inch, ...	–	3.35	–	8.10
	100.00	100.00	100.00	100.00

Chemical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C., ...	8.12	11 24	6.31	6.92
Ash, ...	41.62	58.66	47.63	68.64
Total phosphoric acid, ...	24.13	20.85	19.72	22.59
Soluble phosphoric acid, ...	.17	4.87	1.16	.20
Reverted phosphoric acid, ...	9.12	1.20	9.34	6.65
Insoluble phosphoric acid, ...	14.75	14.78	9.22	15.74
Nitrogen, ...	3.60	2.85	6.84	4.82
Insoluble matter, ...	.55	.48	.71	3.23

Ground Bones.

[I. Sent on from Amherst, Mass. II. Sent on by A. S. Belcher, North Easton, Mass. III. Sent on by Edmund Hersey, Hingham, Mass. IV. Sent on by W. W. Sanderson, South Deerfield, Mass.]

Mechanical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Fine, smaller than $\frac{1}{50}$ inch,	22.59	18.53	34.79	59.00
Fine medium, smaller than $\frac{1}{25}$ inch,	18.71	10.14	21.22	24 09
Medium, smaller than $\frac{1}{12}$ inch,	24.61	7.12	14.71	12.32
Coarser than $\frac{1}{12}$ inch,	34.09	64.21	29.28	4.59
	100.00	100.00	100.00	100.00

Chemical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	3.97	12.43	6.75	9.96
Ash,	49.35	64.21	61.35	55.83
Total phosphoric acid,	19.49	25.67	24.71	18.41
Soluble phosphoric acid,	–	.13	:09	2.73
Reverted phosphoric acid,	3 80	6.20	8.10	9.94
Insoluble phosphoric acid,	15.69	19.34	16.52	5.74
Nitrogen,	4.04	2.68	3.14	3.12
Insoluble matter,	.78	.42	.42	5.79

Phosphate Slag.

[I. German "Phosphate Slag," New York. II. "Phosphate Slag" sent on from England.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	5.08	.37
Ferric oxide and aluminum oxide,	15.98	8.55
Total phosphoric acid,	21.05	18.91
Calcium oxide,	53.97	49.22
Magnesium oxide,	3.83	Not determined.
Insoluble matter,	Not determined.	5.06

This material has been of late introduced into our markets in a fine-ground state as "phosphate meal," manufactured of the "Peine-Thomas Scoria." P. Weidinger, No. 76 Pine Street, New York City, who has advertised the sale of the above material for trial, makes the following statement: —

"We offer to the American fertilizer trade the article above stated, whose rapid and successful introduction into various countries, with constantly increasing demand, gives us a guarantee that its importance for agriculture will not be underrated. This is a very finely ground phosphate meal, obtained from the so-called 'Peine-Thomas Scoria,' through the dephosphorization of pig iron, after the patented method of Sidney Gilchrist Thomas. The dephosphorization of the iron takes place by melting the iron with lime in a current of air, a proceeding by which pig iron, rich in phosphorus, is converted into steel, free from phosphorus (ingot iron). In this manner the phosphorus of the pig iron is converted into phosphoric acid, which, uniting with the lime added, forms phosphate of lime. The melted mixture of phosphate of lime with excess of lime and combinations of the iron and manganese, obtained by this proceeding, is called 'Thomas Scoria.' It is brought into the market for the purposes of agriculture in a finely ground state."

The phosphoric acid present is neither to any extent soluble in water nor in a solution of citrate of ammonia. The composition of the slag is peculiar, on account of an excess of caustic lime, which favors a breaking up into minute particles when exposed to air and moisture. The more finely ground when exposed to atmospheric influences, the more rapidly takes place a general disintegration. This behavior tends to diffuse the phosphoric acid, and favors absorption by the roots. No previous treatment by acids has been found necessary to secure satisfactory returns when used as a phosphoric acid source for plant growth. On account of the alkaline reaction of the "phosphate meal," no ammonia salts or organic nitrogen compounds are used as an admixture for the production of more complete fertilizers. In case nitrogen shall be applied, nitrate of soda is used, to furnish that element. Muriate of potash and kainite are recommended as potash sources.

European agricultural chemists speak well of this new source of phosphoric acid. As it is claimed that phosphoric acid can be furnished at less cost and more efficiently in the form of "phosphate meal" than in any of our known mineral resources of insoluble phosphoric acid, it seems desirable that experiments should be instituted to test its merits.

Fifteen dollars per 2,000 pounds has been asked in our vicinity for a finely ground material.

Concentrated Flower Food.

[Sent on from Springfield, Mass.]

	Per cent.
Moisture at 100° C.,	11.20
Ash,	42.89
Phosphoric acid,	5.30
Sulphuric acid,	15.73
Potassium oxide,	4.72
Sodium oxide,	17.45
Calcium oxide,	6.18
Nitrogen in organic matter,	2.31
Nitrogen in nitrates,	4.66
Insoluble matter,	.25

Compound Fertilizers.

[I. Sent on by A. S. Hawley, North Hadley, Mass. II. Sent on by Staples & Phillips, Taunton, Mass. III. Sent on by C. M. Allen, Franklin, Mass. IV. Sent on by F. G. Arnold, Swansea, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	10.86	11.71	6.76	6.26
Ash,	48.44	57.84	52.96	56.88
Total phosphoric acid,	11.07	13.30	8.32	12 56
Soluble phosphoric acid,	5.87	5.80	2.86	2.09
Reverted phosphoric acid,	3.60	1.85	5.01	6.10
Insoluble phosphoric acid,	1.60	5.65	.45	4.37
Nitrogen in organic matter,	1.65	2.10	.19	3.78
Nitrogen in nitrate,	–		3.44	
Potassium oxide,	3.19	1.63	8.60	9.87
Insoluble matter,	5.50	6.01	1.52	3.03

Compound Fertilizers.

[I. Sent on by A. Bradley, Lee, Mass. II. Sent on by F. H. Bardwell, Hatfield, Mass. III. and IV. Sent on by Oscar L. Dorr, Sharon, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	12.43	12 34	10.50	19.47
Ash,	41.15	64.14	56.62	50.40
Total phosphoric acid,	8 90	12.33	12.86	8.32
Soluble phosphoric acid,	7.45	5.65	4.72	4.02
Reverted phosphoric acid,	1.06	3.22	5.25	2.02
Insoluble phosphoric acid,	.39	3.46	2.89	2.28
Potassium oxide,	7.28	1.34	5.00	2.54
Nitrogen,	4.73	1.52	3.80	3.28
Insoluble matter,	.94	6.56	1.61	10.19

Compound Fertilizers.

[I. Sent on by J. M. Aiken, Prescott, Mass. II. Sent on by W. W. Sanderson, South Deerfield, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.47	6.26
Ash,	54.21	62.53
Total phosphoric acid,	13.61	9.88
Soluble phosphoric acid,	3.91	3.97
Reverted phosphoric acid,	6.24	3.09
Insoluble phosphoric acid,	3.46	2.82
Potassium oxide,	1.45	3.54
Nitrogen,	2.48	1.38
Insoluble matter,	7.44	7.38

Compound Fertilizers.

[I. Sent on by Lawrence Hardware Co., Lawrence, Mass. II. Sent on by J. M. Aiken, Prescott, Mass. III. Sent on by A. Bradley, Lee, Mass. IV. Sent on by J. M. Aiken, Prescott, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	10.36	10.66	17.07	13.34
Ash,	59.19	60.64	44.24	49.38
Total phosphoric acid,	16.44	12.50	9.28	13.02
Soluble phosphoric acid,	4.03	5.50	7.47	6.81
Reverted phosphoric acid,	8.46	1.29	1.43	2.56
Insoluble phosphoric acid,	3.95	5.71	.38	3.65
Potassium oxide,	1.15	2.50	7.64	2.16
Nitrogen,	2.65	1.70	1.34	3.02
Insoluble matter,	3.43	8.09	1.69	5.07

VALUATION OF FERTILIZERS AND FERTILIZER ANALYSES.

The hitherto customary valuation of manurial substances is based on the average trade value of the fertilizing elements specified by analyses. The money value of the higher grades of agricultural chemicals, and of the higher-priced compound fertilizers, depends in the majority of cases on the amount and the particular form of two or three essential articles of plant food, *i. e.*, phosphoric acid, nitrogen and potash, which they contain. The valuation which usually accompanies the analyses of these goods shall inform the consumer, as far as practicable, regarding the cash retail price at which the several specified essential elements of plant food, in an efficient form, have been offered of late for sale in our large markets.

The market value of low-priced materials used for manurial purposes, such as salt, wood ashes, various kinds of lime, barn-yard manure, factory refuse, and waste materials of different descriptions, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for a speedy action, exert, as a rule, a decided influence on their selling price.

The market price of manurial substances is liable to serious fluctuations; for supply and demand exert here, as well as in other branches of commercial industry, a controlling influence on their temporary money value. As farmers in many instances have but little chance to obtain the desired information, agricultural chemists charged with the inspection of commercial fertilizers assist in the work, by ascertaining as far as practicable the actual market price of the leading

manurial substances in our principal markets for a given period of time. The results of the inquiries into the condition of the trade during the six months preceding the 1st of March, 1888, are embodied in the subsequent tabular statement of cost of fertilizing ingredients for the opening of the season of 1888.

The market reports of centres of trade in New England, New York and New Jersey, aside from consultation with leading manufacturers of fertilizers, and notes on actual sales of individual farmers and farmers' associations, etc., furnish the necessary information regarding the current trade value of fertilizing ingredients. The subsequent statement of cash values in the retail trade is obtained by taking the average of the wholesale quotations in New York and Boston, during the six months preceding March 1, 1888, and increasing them by twenty per cent., to cover expenses of sales, credits, etc.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals.

	1888. Cents per Pound.
Nitrogen in ammoniates,	17½
Nitrogen in nitrates,	16
Organic nitrogen in dry and fine-ground fish, meat, blood, cotton-seed meal and castor pomace,	16½
Organic nitrogen in fine-ground bone and tankage,	16½
Organic nitrogen in fine-ground medium bone and tankage,	13
Organic nitrogen in medium bone and tankage,	10½
Organic nitrogen in coarser bone and tankage,	8½
Organic nitrogen in hair, horn-shavings and coarse fish scrap,	8
Phosphoric acid soluble in water,	8
Phosphoric acid soluble in ammonium citrate,*	7½
Phosphoric acid in dry-ground bone, fish bone and tankage,	7
Phosphoric acid in fine medium bone and tankage,	6
Phosphoric acid in medium bone and tankage,	5
Phosphoric acid in coarser bone and tankage,	4
Phosphoric acid in fine-ground rock phosphate,	2
Potash as high-grade sulphate, and in forms free from muriate and chlorides,	5½
Potash as kainite,	4¼
Potash as muriate,	4¼

*Dissolved from two grams of phosphate unground, by 100 C. C. neutral solution of ammonium citrate, sp. gr. 1.09 in thirty minutes at 65° C., with agitation once in five minutes; commonly called "reverted" or "back-gone" phosphoric acid.

The above trade values are the figures at which, in the six months preceding March 1, the respective ingredients could be bought at retail for cash in our large markets, in the raw materials which are the regular source of supply.

They also correspond to the average wholesale prices for the six months ending March 1, plus about twenty per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the reasonable retail price at the large markets of standard raw materials, such as —

Sulphate of ammonia,	Dried ground fish,
Nitrate of soda,	Azotin,
Muriate of potash,	Ammonite,
Sulphate of potash,	Castor pomace,
Dried blood,	Bone and tankage,
Dried ground meat,	Plain superphosphates.

To obtain the valuation of a fertilizer (*i. e.*, the money worth of its fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound. We thus get the values per ton of the several ingredients, and, adding them together, we obtain the total valuation per ton in case of cash payment at points of general distribution.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value, in case of one and the same kind of substances. Two samples of fish fertilizer, although equally pure, may differ from fifty to one hundred per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers and refuse materials of various descriptions, sent to the Station for examination, are valued with reference to the market prices of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

A large percentage of commercial fertilizing material consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industry is liable to affect at any time, more or less seriously, the composition of the refuse. A constant inquiry into the character of the agricultural chemicals, and of commercial manurial refuse substances offered for sale, cannot fail to secure confidence in their composition, and to diminish financial disappointment in consequence of their application. This work is carried on for the purpose of aiding the farming community in a clear and intelligent appreciation of these substances for manurial purposes.

Consumers of commercial manurial substances do well to buy, whenever practical, on guaranty of composition with reference to their essential constituents, and see to it that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest stated quantity of each specified essential constituent.

Analyses of Water sent on for Examination.

[Parts per Million.]

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at red heat.	Hardness (Clark's degree).	Lead.	Locality.
I.,	.108	.160	17.80	148.00	60.00	4.03	-	No. Amherst.
II.,	.01	.06	7.00	104.00	56.00	4.57	None.	Amherst.
III.,	.23	.34	47.00	312.00	206.00	9.14	None.	Amherst.
IV.,	.25	.44	19.00	202.00	68.00	2.86	Present.	Littleton.
V.,	.09	.10	6.00	132 00	72.00	3.25	None.	No. Amherst.
VI.,	.40	.12	137.20	546.00	124.00	-	-	Amherst.
VII.,	.03	.05	6.00	64.00	46.00	1.56	None.	Ipswich.
VIII.,	SO_3 — CaO —	82.00 63.00	64.00	310.00	100.00	9.57	-	Ashby.
IX.,	.12	.09	None	38.00	30.00	.63	-	Ashby.
X.,	.08	.08	42.00	300.00	76.00	7.00	-	Ashby.
XI.,	.17	.05	20 00	192.00	104.00	3.12	None.	No. Amherst.
XII.,	.07	.02	9.00	138.00	60.00	2.86	None.	Ashby.
XIII.,	None	.02	20.00	178.00	70.00	1.82	None.	Ashby.
XIV.,	.44	.28	22.00	160.00	40.00	3.12	None.	Ashby.
XV.,	.05	.18	144.00	530.00	102.00	5.43	None.	Ashby.
XVI.,	.13	.46	None	70.00	36.00	1.43	-	Amherst.
XVII.,	.08	.08	42.00	354.00	108.00	5.29	None.	Amherst.
XVIII.,	.12	.28	6.00	86.00	26.00	1.43	None.	East Amherst.
XIX.,	.05	.44	20.00	146.00	52.00	4.57	None.	East Amherst.
XX.,	None	.04	9.00	72.00	24.00	1.27	None.	East Amherst.
XXI.,	.26	.24	20.00	124.00	46.00	1.11	None.	Boston.
XXII.,	.10	.10	9.10	72.00	52.00	1.11	None.	Boston.
XXIII.,	.64	.36	45 00	268.00	96.00	8.43	-	Sherborn.
XXIV.,	None	.06	12.00	106.00	56.00	2.21	None.	Wellesley.
XXV.,	None	.09	25.04	318.00	76.00	7.86	Present.	No. Hadley.
XXVI.,	-	-	-	-	-	-	None.	No. Hadley.
XXVII.,	.066	.14	18.00	208.00	96.00	5.00	-	No. Amherst.
XXVIII.,	3.33	.80	127.00	720.00	224.00	10.00	None.	No. Hadley.
XXIX.,	Trace	.06	Trace	38.00	30.00	1.69	None.	No. Hadley.
XXX.,	None	.06	31.00	196.00	76.00	3.51	None.	Shirley.
XXXI.,	1.30	.40	47.40	7.14	380.00	98.00	None.	Shirley.
XXXII.,	.08	.06	8.00	98.00	22.00	2.60	None.	No. Amherst.
XXXIII.,	4.70	1.50	125.00	844.00	182.00	10.10	-	No. Hadley.
XXXIV.,	.12	.20	None	40 00	24.00	-	-	Amherst.
XXXV.,	.09	.09	Trace	68.00	28.00	-	-	Amherst.
XXXVI.,	.12	.05	3.00	68.00	26.00	2.21	None.	Amherst.

ANALYSES OF WATER — *Continued.*

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at red heat.	Hardness (Clark's degree).	Lead.	LOCALITY.
XXXVII., .	.02	.04	None	38.00	22.00	–	–	Worthington.
XXXVIII., .	.01	.05	None	52.00	30.00	.79	–	Worthington.
XXXIX., .	Trace	.02	None	22.00	14.00	1.43	–	Worthington.
XL., . .	1.15	.05	28.00	306.00	82.00	7.86	–	Amherst.
XLI., . .	.02	.14	None	24.00	12.00	–	–	Worthington.
XLII., . .	Trace	.02	Trace	54.00	40.00	.95	–	Worthington.
XLIII., . .	.04	.03	None	52.00	36.00	2.08	–	Worthington.
XLIV., . .	–	–	–	–	–	–	Present.	East Amherst.
XLV., . .	–	–	–	–	–	–	None.	East Amherst.
XLVI., . .	–	–	–	–	–	–	None.	Amherst.
XLVII., . .	–	–	–	–	–	–	None.	Berlin.
XLVIII., .	Trace	.05	None	22.00	2.00	–	–	Worthington.
XLIX., . .	.12	.12	None	148.00	64.00	1.56	None.	No. Hadley.
L., . . .	.14	.58	.60	74.00	34.00	3.12	None.	Westhampton.
LI., . . .	.05	.20	5.00	86.00	54.00	2.34	None.	Wellesley.
LII., . .	.10	.14	Trace	238.00	114.00	7.00	–	So. Hadley.
LIII., . .	.01	.10	23.00	154.00	50.00	2.86	–	Ashby.
LIV., . .	1.40	7.90	4.00	422.00	322.00	17.06	None.	Amherst.
LV., . . .	1.50	.70	126.00	482.00	198.00	8.29	None.	Amherst.
LVI., . .	.40	.55	8.00	142.00	58.00	3.90	None.	Amherst.
LVII., . .	.01	.016	2.00	148.00	64.00	4.71	Present.	Amherst.
LVIII., . .	.02	.05	18.00	148 00	40.00	4.86	None.	Amherst.
LIX., . .	.04	.05	11.00	52.00	16.00	1.95	None.	Amherst.
LX., . .	.05	.05	9.00	20.00	8.00	1.56	None.	Amherst.
LXI., . .	.03	.04	13.00	116.00	60 00	2.86	None.	Amherst.
LXII., . .	.01	.07	34.00	292.00	156.00	5.86	None.	Amherst.
LXIII., . .	.03	.10	6.00	216.00	44.00	5.00	None.	Amherst.
LXIV., . .	.03	.16	Trace	88.00	48 00	.32	None.	Amherst.
LXV., . .	1.36	1.20	57.00	412.00	108.00	8.14	–	Amherst.
LXVI., . .	.003	.04	24.00	120.00	56.00	6.29	–	Amherst.
LXVII., . .	.016	.044	3.00	140.00	70.00	.63	None.	No. Dana.
LXVIII., .	.45	.35	8.00	52.00	20.00	1.56	None.	No. Amherst.
LXIX., . .	.06	.10	22.00	116.00	26 00	2.21	None.	Amherst.
LXX., . .	.026	.08	38.00	324.00	160.00	8.29	None.	Amherst.
LXXI., . .	.024	.044	22.00	308.00	64 00	5.14	None.	Amherst.
LXXII , . .	.124	.148	2.00	56.00	12.00	1 11	None.	Amherst.
LXXIII., .	–	.05	Trace	45.00	35 00	1.56	None.	Littleton.

ANALYSES OF WATER — *Concluded.*

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at red heat.	Hardness (Clark's degree).	Lead.	LOCALITY.
LXXIV., .	.06	.05	53.00	325.00	177.00	7.43	None.	Northampton.
LXXV., . .	Trace	.04	25.00	212.00	112.00	4.86	–	Amherst.
LXXVI., .	.04	.06	19.00	92.00	40.00	.95	–	Amherst.
LXXVII., .	.07	.05	Trace	62.00	42.00	.79	None.	Amherst.
LXXVIII., .	.04	.22	Trace	34.00	4.00	–	–	Amherst.
LXXIX., .	.01	.04	3.00	68.00	22.00	1.56	None.	Amherst.
LXXX., . .	.02	.07	5.00	40.00	10.00	1.11	None.	Amherst.
LXXXI., .	.03	.08	12.00	112.00	51.00	2.99	None.	Framingham.
LXXXII., .	Trace	.18	13.00	153.00	94.00	3.25	None.	Amherst.
LXXXIII., .	.03	.10	Trace	70.00	45.00	1.11	None.	Sunderland.
LXXXIV., .	.04	.08	Trace	45.00	30.00	–	None.	Northampton.
LXXXV., .	.04	.07	15.00	111.00	70.00	3.79	None.	Northampton.

The analyses have been made according to Wancklyn's process, familiar to chemists, and are directed towards the indications of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals, lead in particular. (For a more detailed description of this method, see "Water Analyses," by J. A. Wancklyn and E. T. Chapman.)

Mr. Wancklyn's interpretation of the results of his mode of investigation is as follows: —

1. Chlorine alone does not necessarily indicate the presence of filthy water.

2. Free and albuminoid ammonia in water, without chlorine, indicates a vegetable source of contamination.

3. More than five grains per gallon* of chlorine (=71.4 parts per million), accompanied by more than .08 parts per million of free ammonia and more than .10 parts per million of albuminoid ammonia, is a clear indication that the water is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.

4. Eight-hundredths parts per million of free ammonia and one-tenth part per million of albuminoid ammonia render a water very suspicious, even without much chlorine.

* One gallon equals 70,000 grains.

5. Albuminoid ammonia over .15 parts per million ought to absolutely condemn the water which contains it.

6. The total solids found in the water should not exceed forty grains per gallon (571.4 parts per million).

An examination of the above results of analyses shows that Nos. 5, 9, 10, 11, 17, 22, 27, 35, 36, 64, 78 and 82 are of a suspicious character, and that Nos. 1, 3, 4, 6, 14, 15, 16, 18, 19, 21, 23, 28, 31, 33, 34, 40, 49, 50, 51, 52, 54, 55, 56, 64, 65, 68 and 72 ought to be condemned, on account of a large amount of free and albuminoid ammonia, due most likely to access of sewage water. An examination of the above statement shows that a large proportion of the samples received were from bad wells. Of fifty-eight samples of water tested for lead, four were found to be poisoned by that metal, in consequence of the use of lead pipes.

A satisfactory supply of good drinking water on a farm depends, in a controlling degree, on a judicious selection of the location of the well designed for the use of the family and for the live stock, and on the personal attention bestowed, from time to time, on the condition of the well and its surroundings. Good wells are liable to change for the worst at any time, on account of circumstances too numerous to state in this connection. To ascertain, from time to time, the exact condition of the water which supplies the wants of the family and of the live stock, is a task which no farmer can, for any length of time, neglect, without incurring a serious risk to health and prosperity.

The subject receives, quite frequently, but little attention, on account of the fact that the harmful qualities which an apparently good water may contain are disguised beyond recognition by the unaided senses. Certain delicate chemical tests, aided at times by microscopic observations, are, in the majority of cases, the only reliable means, in our present state of scientific inquiry, by which desirable information regarding the true character of a drinking water can be obtained.

Parties sending on water for an analysis ought to be very careful to use clean vessels, clean stoppers, etc. The samples should be sent on without delay after collecting. One gallon is desirable for the analysis.

Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.*

Prepared by Mr. W. H. Beal.

As the basis of valuation changes from year to year, no valuation is stated.

1868 to 1889

Muriate of Potash (45 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	4.05	.05	2.05
Potassium oxide,	58.98	45.94	52.46
Sodium oxide,	11.26	2.13	6.69
Magnesium oxide,	.90	.30	.55
Chlorine,	54.00	43.20	48.60
Insoluble matter,	2.00	.15	.75

Sulphate of Potash (15 Analyses).

Moisture at 100° C.,	5.00	.19	1.00
Potassium oxide,	51.28	20.44	35.86
Sodium oxide,	8.59	.34	4.46
Magnesium oxide,	2.63	.24	1.50
Sulphuric acid,	59.30	10.86	45.00
Insoluble matter,	31.55	.14	.75

* This compilation does not include the analyses made of licensed fertilizers. They are to be found in the Reports of the State Inspector of Fertilizers from 1873 to 1889, contained in the Reports of the Secretary of the Massachusetts State Board of Agriculture for those years. C. A. G.

Sulphate of Potash and Magnesia (13 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	11.58	1.95	5.50
Potassium oxide,	27.77	11.70	22.50
Sodium oxide,	18.97	2.09	6.50
Magnesium oxide,	13.66	10.86	12.25
Calcium oxide,	3.38	.82	2.50
Sulphuric acid,	47.90	31.91	43.00
Chlorine,	7.80	.14	2.50
Insoluble matter,	2.36	.26	1.41

German Potash Salts (11 Analyses).

Moisture at 100° C.,	25.83	.45	13.14
Potassium oxide,	50.40	7.56	21.63
Sodium oxide,	26.23	1.30	13.76
Calcium oxide,	1.26	.06	.85
Magnesium oxide,	9.83	Trace.	9.25
Sulphuric acid,	21.53	.17	10.85
Chlorine,	49.11	22.27	35.63
Insoluble matter,	3.76	.90	2.08

Kainite (3 Analyses).

Moisture at 100° C.,	13.57	2.15	9.26
Potassium oxide,	16.48	12.51	14.04
Sodium oxide,	–	–	21.38
Calcium oxide,	1.41	.82	1.12
Magnesium oxide,	11.30	6.65	8.97
Sulphuric acid,	23.71	17.53	21.05
Chlorine,	–	–	32.38
Insoluble matter,	1.56	.17	.86

Carnallite (1 Analysis).

	Per cent.
Potassium oxide,	13.68
Sodium oxide,	7.66
Magnesium oxide,	13.19
Sulphuric acid,	.56
Chlorine,	41.56

Krugite (1 Analysis).

	Per cent.
Moisture at 100° C.,	4.82
Calcium oxide,	12.45
Magnesium oxide,	8.79
Potassium oxide,	8.42
Sodium oxide,	5.57
Sulphuric acid,	31.94
Chlorine,	6.63
Insoluble matter,	14.96

Sulphate of Magnesia (9 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	31.90	7.50	22.50
Calcium oxide,	3.89	1.15	2.52
Magnesium oxide,	25.29*	13.50	18.25
Sulphuric acid,	52.23*	31.91	37.00
Insoluble matter,	11.06	.40	5.73

* Kieserite, natural and calcined.

Nova Scotia Plaster (9 Analyses).

Moisture at 100° C.,	15.79	.52	6.50
Calcium oxide,	37.59	30.60	33.50
Magnesium oxide,	1.40	.36	.75
Sulphuric acid,	54.10	33.56	44.00
Insoluble matter,	7.95	.45	2.00

Onondaga Plaster * (7 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	22.25	8.95	13.27
Calcium oxide,	31.46	29.15	30.00
Magnesium oxide,	6.06	3.89	4.66
Sulphuric acid,	36.00	31.58	33.00
Carbonic acid,	8.80	7.20	8.20
Insoluble matter,	12.00	8.28	9.83

* Contains 1 sample of Cayuga plaster.

Gypseous Shale (1 Analysis).

	Per cent.
Calcium sulphate,	38.55
Calcium carbonate,	11.05
Magnesium carbonate,	2.65
Insoluble matter,	37.15

Gas-house Lime (4 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	33.55	11.01	22.28
Calcium oxide,	45.80	40.00	42.66
Magnesium oxide,	8.30	8.30	8.30
Sulphuric acid,*	20.73	20.73	20.73
Insoluble matter,	15.00	.40	6.05

* Sulphuric acid includes all forms of sulphur present.

Lime Waste.

	Per Cent.		
	Liquid from Lime-vats (evaporated).	Mass from bottom of Lime-vats.	Lime waste from Sugar Factory.
Moisture at 100° C.,	11.50	17.54	36.30
Ash,	41.00	65.24	–
Calcium oxide,	23.40	47.80	27.51
Magnesium oxide,	–	–	Trace.
Potassium oxide,	–	–	.22
Phosphoric acid,	.77	.81	2.25
Nitrogen,	6.87	1.06	–
Insoluble matter,	.10	5.50	.32

Lime-kiln Ashes (7 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	30.70	.20	15.45
Calcium oxide,	50.16	36.00	43.08
Magnesium oxide,	4.45	1.26	2.60
Potassium oxide,	1.70	.02	.86
Phosphoric acid,	3.16	Trace.	1.18
Carbonic acid,	39.36	9.66	16.66
Insoluble matter,	53.77	3.30	14.54

Marls * (5 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	55.80	.60	18.18
Calcium oxide,	50.61	20.72	40.07
Magnesium oxide,	1.03	.22	.64
Iron and alumina,	1.00	.36	.69
Phosphoric acid,	2.72	.07	1.05
Carbonic acid,	40.38	16.63	28.51
Insoluble matter,	3.44	3.44	3.44

* Massachusetts.

Virginia Marl.

	Per Cent.	
	2 feet below Surface.*	4 feet below Surface.†
Moisture at 100° C.,	16.70	15.26
Calcium oxide,	9.21	5.29
Magnesium oxide,	.25	.16
Potassium oxide,	.61	.37
Phosphoric acid,	.09	.08
Sulphuric acid,	1.00	.31
Carbonic acid,	4.23	1.76
Insoluble matter,	59.59	68.86

* No. 1 contained a large amount of shells. † No. 2 was largely sand.

Wood Ashes. (Canada.) (87 Analyses.)

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	28.57	.70	12.00
Calcium oxide,	50.89	18.00	34.44
Magnesium oxide,	7.47	2.28	3.50
Iron oxide,	–	–	.83
Potassium oxide,	10.24	2.49	5.50
Phosphoric acid,	3.99	.29	1.85
Insoluble matter,	24.10	2.10	12.50

Cotton-seed Hull Ashes (23 Analyses).

Moisture at 100° C.,	26.81	2.30	7.33
Calcium oxide,	39.75	3.35	10.00
Magnesium oxide,	17.15	2.02	9.50
Iron oxide,	–	–	1.50
Potassium oxide,	42.12	5.00	20.95
Phosphoric acid,	13.67	.76	7.52
Insoluble matter,	32.48	5.38	11.79

Ashes of Spent Tan-bark (3 Analyses).

Moisture at 100° C.,	7.45	4.87	6.31
Calcium oxide,	37.26	31.35	33.46
Magnesium oxide,	5.10	2.57	3.55
Potassium oxide,	2.87	1.14	2.04
Phosphoric acid,	2.77	.13	1.61
Insoluble matter,	24.33	24.33	24.33

Ashes of Waste Products.

	Per Cent.		
	Chestnut R. R. Ties.	Logwood.	Mill.
Moisture at 100° C.,	6.15	1.50	.53
Calcium oxide,	4.71	3.90	34.93
Magnesium oxide,	1.80	Trace.	1.35
Potassium oxide,	.19	.08	1.60
Phosphoric acid,	1.54	2.30	.46
Insoluble matter,	77.83	9.70	36.36

Hard Pine Wood Ashes.

	Per cent.
Moisture at 100° C.,	.75
Calcium oxide,	24.95
Magnesium oxide,	8.39
Potassium oxide,	10.16
Phosphoric acid,	2.24
Insoluble matter,	29.90

Nitrate of Potash (2 Analyses).

	Per cent.	
Moisture at 100° C.,	1.75	2.10
Potassium oxide,	44.76	45.62
Nitrogen,	11.60	14.58
Insoluble matter,	Trace.	

Nitrate of Soda (13 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	2.00	.85	1.25
Sodium oxide,	70.97	35.00	35.50
Calcium oxide,	.41	Trace.	Trace.
Magnesium oxide,	.04	Trace.	Trace.
Nitrogen,	16.26	14.44	15.75
Sulphuric acid,	.20	Trace.	Trace.
Chlorine,	2.52	.20	.50
Insoluble matter,	.90	.24	.50

Saltpetre Waste from Gunpowder Works (7 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	4.24	.50	2.75
Potassium oxide,	30.94	4.65	18.00
Sodium oxide,	45.92	22.08	34.00
Calcium oxide,	.83*	.71*	.75
Magnesium oxide,	.28*	.09*	.19
Nitrogen,	3.30	.80	2.43
Sulphuric acid,	4.85*	.84*	2.85
Chlorine,	56.00	37.66	48.30

* Only estimations reported.

Nitre Salt-cake (2 Analyses).

Moisture at 100° C.,	6.71	5.34	6.03
Potassium oxide,	.87	Trace.	.87
Sodium oxide,	32.72	26.40	29.56
Nitrogen,	2.29	–	2.29
Sulphuric acid,	48.85	46.69	47.77
Insoluble matter,	4.12	3.73	3.92

Sulphate of Ammonia (22 Analyses).

Moisture at 100° C.,	2.40	.13	1.00
Nitrogen,	22.23	19 70	20.50
Sulphuric acid,	70.70	57.68	60.00
Insoluble matter,	–	–	Trace.

Ammonite.

	Per cent.
Moisture at 100° C.,	5.88
Phosphoric acid,	3.43
Nitrogen,	11.33
Insoluble matter,	1.38

Dried Blood (11 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	21.52	7.65	12.50
Ash,	10.04	3.56	6 37
Phosphoric acid,	6.23	1.53	1.91
Nitrogen,	13.55	7.80	10.52

Refuse Materials (Animal).

	Per Cent.		
	Oleomargarine Refuse.	Felt Refuse.	Sponge Refuse.
Moisture at 100° C.,	8.54	39.24	7.25
Ash,	14.42	33.53	–
Calcium oxide,	–	–	3.94
Magnesium oxide,	–	–	1.27
Phosphoric acid,	.88	–	3.19
Nitrogen,	12.12	5.26	2.43
Insoluble matter,	.96	8.44	39.05

Horn and Hoof Waste (3 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	10.27	10.08	10.17
Ash,	14.62	1.05	7.63
Phosphoric acid,	–	–	2.30
Nitrogen,	16.10	11.84	14.47
Insoluble matter,	–	–	.24

Wool Waste (3 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	10.12	8.43	9.27
Nitrogen,	6.25*	5.00	5.62

* Saturated with oil.

Raw Wool and Wool Washings.

	Per Cent.			
	Raw Wool.	Water Washings.	Acid Washings.	Liquid from Wool Washings.
Moisture at 100° C.,	6.95	–	–	92.03
Ash,	7.54	–	–	3.28
Fat,	3.92	–	–	–
Calcium oxide,	–	.28	.61	.04
Magnesium oxide,	–	None.	.20	Trace.
Potassium oxide,	–	3.92	4.20	1.09
Sodium oxide,	–	.49	.40	.92
Nitrogen,	12.88	–	–	.09
Insoluble matter,	3.63	–	–	.22

Meat Mass (6 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	18.75	8.16	12.09
Ash,	14.66	2.90	13.60
Total phosphoric acid,	3.58	.56	2.07
Nitrogen,	11.50	9.69	10.44
Insoluble matter,	.77	.40	.58

Refuse from Rendering Establishments.

	Per Cent.					
	Bone Soup.	Dried Soup from Meat and Bone.	Dried Soup from Rendering Cattle Feet.	Soup from Horse Rendering Factory.	Soap Grease Refuse. I.	Soap Grease Refuse. II.
Moisture at 100° C.,	82.92	14.80	10.80	92.14	38.79	19.70
Ash,	7.07	8.40	7.50	–	43.13	59.65
Phosphoric acid,	1.26	.53	.46	.14	11.04	15.37
Nitrogen,	1.14	9.97	14.47	1.12	2.21	4.20
Insoluble matter,	–	.64	.26	–	1.20	1.37

Bones (103 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	11.90	3.05	7.47
Ash,	74.90	37.25	56.07
Total phosphoric acid,	29.83	12.06	22.50
Soluble phosphoric acid,	.76	.10	.43
Reverted phosphoric acid,	16.78	2.24	6.50
Insoluble phosphoric acid,	23.37	8.13	15.70
Nitrogen,	6.75	1.50	4.12
Insoluble matter,	6.00	.04	2.00

Tankage (12 Analyses).

Moisture at 100° C.,	28.09	5.46	14.61
Ash,	37.06	19.40	23.23
Total phosphoric acid,	14.60	8.00	10.67
Soluble phosphoric acid,	.27	.27	.27
Reverted phosphoric acid,	–	–	3.25
Insoluble phosphoric acid,	–	–	8.79
Nitrogen,	8.07	5.82	7.08
Insoluble matter,	2.00	.56	1.23

Fish containing 20 per cent. or less of Moisture (47 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	19.88	6.61	13.24
Ash,	72.23	15.99	20.00
Total phosphoric acid,	16.64	4.33	8.25
Soluble phosphoric acid,	1.70	.37	.55
Reverted phosphoric acid,	4.57	1.78	2.17
Insoluble phosphoric acid,	7.16	2.11	3.80
Potassium oxide,	.45	.45	.45
Nitrogen,	10.24	3.87	7.05
Insoluble matter,	4.99	.74	2.50

Fish containing between 20 per cent. and 40 per cent. of Moisture (8 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	38.11	20.58	29.34
Ash,	36.50	16.87	24.14
Total phosphoric acid,	8.90	5.60	7.25
Soluble phosphoric acid,	–	–	.82*
Reverted phosphoric acid,	–	–	2.87*
Insoluble phosphoric acid,	–	–	3.99*
Potassium oxide,	–	–	.85†
Nitrogen,	7.41	4.22	5.81
Insoluble matter,	2.89	.82	1.85

* Fish pomace. † Dry ground fish.

Fish containing 40 per cent. and more of Moisture (12 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	50.58	40.35	45.46
Ash,	20.78	1.92*	12.50
Total phosphoric acid,	8.56	1.02*	5.08
Soluble phosphoric acid,	1.51	.83	1.17
Reverted phosphoric acid,	2.02	.64	1.33
Insoluble phosphoric acid,	3.62	1.88	2.75
Nitrogen,	7.60	2.43	4.97
Insoluble matter,	2.44	.16	1.35

* Fish-liver refuse.

Whale Flesh.

	Per Cent.			
	Raw.	Dry (with Fat).	Dry (without Fat).	Whale Scrap.
Moisture at 100° C.,	44.50	–	–	9.51
Ash,	1.04	1.86	3.20	11.74
Fat,	22.81	40.70	–	–
Flesh,	32.10	57.44	96.80	–
Nitrogen,	4.86	8.68	14.60	9.64

Lobster Shells.

	Per cent.
Moisture at 100° C.,	7.27
Calcium oxide,	22.24
Magnesium oxide,	1.30
Phosphoric acid,	3.52
Nitrogen,	4.50
Insoluble matter,	.27

Peruvian Guano (26 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	22.61	7.02	14.81
Ash,	61.65	13.58	37.61
Total phosphoric acid,	23.10	3.43	13.26
Soluble phosphoric acid,	8.80	.35	4.57
Reverted phosphoric acid,	6.20	1.38	3.79
Insoluble phosphoric acid,	16.50	4.67	10.58
Potassium oxide,	4.08	1.14	2.61
Nitrogen,	11.26	4.44	7.85
Insoluble matter,	11.91	1.30	6.60

Bat Guano (9 Analyses).

[One sample contained 1.31 per cent. potassium oxide.]

Moisture at 100° C.,	72.38	7.80	40.09
Ash,	72.14	4.34	38.24
Phosphoric acid,	6.53	1.00	3.76
Nitrogen as nitrates,	1.80	.24	1.02
Nitrogen as ammoniates,	3.42	1.49	2.45
Nitrogen in organic matter,	5.66	.34	3.00
Insoluble matter,	54.15	.20	2.00

Cuba Guano (7 Analyses).

Moisture at 100° C.,	36.85	12.10	24.27
Potassium oxide,	1.20	.14	.67
Phosphoric acid,	24.35	11.54	17.94
Nitrogen as nitrates,	1.00	.24	.62
Nitrogen as ammoniates,	.26	.14	.20
Nitrogen in organic matter,	1.48	.23	.85
Insoluble matter,	3.40	2.95	3.17

Caribbean Guano (Orchilla) (10 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	12.50	2.12	7.31
Calcium oxide,	45.00	34.91	39.95
Magnesium oxide,	4.13	2.46	3 29
Phosphoric acid,	35.43	18.11	26.77
Sulphuric acid,	2.36	1.80	2.08
Insoluble matter,	2.40	.17	1.27

South American Bone Ash.

	Per cent.
Moisture at 100° C.,	7.00
Calcium oxide,	44.89
Phosphoric acid,	35.89
Insoluble matter,	4.50

South Carolina Rock Phosphate (4 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	1.90	.10	1.50
Calcium oxide,	–	–	41.87*
Magnesium oxide,	–	–	3.03*
Iron and alumina oxide,	–	–	4.26*
Total phosphoric acid,	30.51	25.81	28.03
Soluble phosphoric acid,	–	–	.27*
Reverted phosphoric acid,	.47	.19	.33
Insoluble phosphoric acid,	30.31	25.07	27.69
Insoluble matter,	13.74	9.18	11.61

* Only estimate.

Navassa Phosphate (2 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	–	–	5.60*
Calcium oxide,	37.67	37.22	37.44
Iron oxide,	11.79	8.75	10.27
Alumina oxide,	–	–	4.24*
Phosphoric acid,	34.45	34.09	34.27
Insoluble matter,	–	–	2.70*

* Only one test.

Brockville Phosphate (1 Analysis).

	Per cent.
Moisture at 100° C.,	2.50
Phosphoric acid,	35.21
Insoluble matter,	6.46

Bone-black (5 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	10.65	1.55	4.60
Phosphoric acid,	30.54	23.47	28.28
Insoluble matter,	6.60	1.53	3.64

Phosphatic Slags.

[I. German phosphatic slag. II. English slag.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	.10	.37
Calcium oxide,	41.87	49.82
Magnesium oxide,	3.03	–
Iron and alumina oxides,	4.26	–
Total phosphoric acid,	30.51	18.91
Soluble phosphoric acid,	–	–
Reverted phosphoric acid,	.19	5.93
Insoluble phosphoric acid,	30.32	12.98
Insoluble matter,	13.74	5.06

Castor Bean Pomace (4 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100 C.,	10.18	9.25	9.98
Calcium oxide,	.96	.77	.87
Magnesium oxide,	.37	.20	.29
Potassium oxide,	1.70	.64	1.12
Phosphoric acid,	2.22	2.03	2.16
Nitrogen,	5.72	5.33	5.56
Insoluble matter,	2.38	1.12	1.75

Cotton Refuse.

	Per Cent.			
	Cotton Dust.	Cotton Waste (Dry).	Cotton Waste (Wet).	Cotton Waste.
Moisture at 100° C.,	34.46	5.53	34.69	8.24
Ash,	50.93	–	–	–
Calcium oxide,	.90	1.45	2.45	2.52
Magnesium oxide,	.90	.87	1.13	.66
Potassium oxide,	.19	.89	.80	1.62
Phosphoric acid,	.21	.84	1.54	.83
Nitrogen,	.50	1.32	1.30	2.09
Insoluble matter,	47.46	49.68	41.33	20.10

Cotton-seed Meal (6 Analyses).

[I. Average of five analyses. II. Damaged.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	6.80	9.90
Ash,	5.77	–
Calcium oxide,	.39	.22
Magnesium oxide,	.99	.56
Potassium oxide,	.89	1.21
Phosphoric acid,	1.45	1.26
Nitrogen,	6.10	3.73
Insoluble matter,	.60	.20

Rotten Brewer's Grain.

	Per cent.
Moisture at 100° C.,	78.77
Calcium oxide,	.26
Magnesium oxide,	.15
Potassium oxide,	.04
Phosphoric acid,	.43
Nitrogen,	.72
Insoluble matter,	.59

Tobacco Stems (5 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	12.18	8.95	10.61
Ash,	15.00	13.30	14.07
Calcium oxide,	4.76	3.39	3.89
Magnesium oxide,	1.40	1.11	1.23
Potassium oxide,	8.82	3.34	6.44
Sodium oxide,	.68	.16	.34
Phosphoric acid,	.87	.44	.60
Nitrogen,	2.69	.90	2.29
Insoluble matter,	1.35	.29	.82

Refuse Materials (Vegetable).

	PER CENT.		
	Glucose Refuse.	Hop Refuse.	Sumac Waste.
Moisture at 100° C.,	8.10	8.98	63.06
Ash,	–	–	6.80
Calcium oxide,	.18	.27	1.14
Magnesium oxide,	.02	.10	3.25
Potassium oxide,	.15	.11	.17
Phosphoric acid,	.29	.20	–
Nitrogen,	2.62	.98	1.19
Insoluble matter,	.07	.63	2.25

Sea-weed.

	PER CENT.				
	EEL-GRASS.		ROCKWEED.		Wet Kelp.
	I.	II.	Green.	Dry.	
Moisture at 100° C.,	45.61	25.17	68.50	10.68	88.04
Ash,	20.39	10.81	23.70	55.75	2.26
Calcium oxide,	1.56	2.70	–	7.66	–
Magnesium oxide,	.09	.12	–	.21	–
Potassium oxide,	1.61	.21	–	4.89	–
Sodium oxide,	2.51	.74	–	7.90	–
Phosphoric acid,	.41	.22	–	2.75	–
Nitrogen,	.70	.96	.62	1.45	.26
Insoluble matter,	.46	1.66	–	10.40	–

Sea-weed Ashes.

	Per cent.
Moisture at 100° C.,	1.47
Calcium oxide,	6.06
Magnesium oxide,	4.37
Potassium oxide,	.92
Sodium oxide,	8.76
Phosphoric acid,	.30
Sulphuric acid,	2.98
Sulphur,	.14
Chlorine,	6.60
Magnesium chloride,	.14
Insoluble matter,	63.65

Rockweed.

[I. Collected in May. II. Collected in December.]

	Per Cent.	
	I.	II.
Fresh wet rockweed lost, in air, of water,	78.700	65.920
Fresh wet rockweed lost, at 100° C., of water,	90.400	76.920
Air-dried rockweed contained, of vegetable matter,	88.220	89.000
Air-dried rockweed contained, of water,	11.780	11.000
The filled pods left, at 100° C., of solid organic matter,	7.360	–
The fresh stems left, at 100° C., of solid organic matter,	30.650	–
The slime of the pods, dried at 100° C., contained, of nitrogen,	2.920	–
Rockweed, entire plant with filled pods, dried at 100° C., contained, of nitrogen,	2.286	1.721
Rockweed, air-dried, contained, of nitrogen,	2.017	1.432
" fresh (wet), contained, of nitrogen,	.487	.397
" dried at 100° C., contained, ashes,	28.930	24.890
" air-dried, contained, ashes,	6.220	22.150
" fresh (wet), contained, ashes,	3.770	5.825
The slime of the pods contained, ashes,	49.356	–

One hundred parts of the ash contained (I.): —

	Per cent.
Potassium oxide,	4 842
Sodium oxide,	12.050
Calcium oxide,	2.691
Magnesium oxide,	2.753
Ferric oxide,	.338
Sulphuric acid,	7.986
Phosphoric acid,	6.240

Mud.

	Per Cent.					
	Mussel Mud.	Mussel Mud.	Salt Mud.	Salt Mud.	Black Mud.	Fresh-Water Mud.
Moisture at 100° C.,	60.01	2.24	46.36	60.37	56.55	40.37
Ash,	27.29	72.02	49.28	33.09	39.60	–
Calcium oxide,	.93	23.39	.90	.91	.91	1.27
Magnesium oxide,	.14	–	.31	.43	.66	.29
Potassium oxide,	6.17	–	.33	.32	.38	.22
Sodium oxide,	.70	–	.94	.94	.86	–
Ferric oxide,	3.48	8.26	4.55	3.70	4.26	1.80
Phosphoric acid,	.10	.35	Trace.	Trace.	Trace.	.26
Nitrogen,	.21	.72	.39	.40	1.64	1.37
Insoluble matter,	–	37.60	43.55	26.20	31.84	18.26

Soil from a Diked Marsh.

	Per cent.
Moisture at 100° C.,	33.40
Ash,	7.85
Calcium oxide,	1.24
Potassium oxide,	.26
Phosphoric acid,	.13
Nitrogen,	1.64
Insoluble matter,	3.65

Muck (11 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	89.89	12.03	55.13
Ash,	26.12	3.05	13.75
Nitrogen,	1.82	.26	.95

Peat (10 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	85.38	11.29*	61.50
Ash,	33.72	1.20	7.71
Calcium oxide,	–	–	.50
Nitrogen,	1.79	.41	.75
Insoluble matter,	–	–	.38

* German peat mass.

Turf (2 Analyses).

	Per Cent.	
	I.	II.
Moisture at 100° C.,	25.58	13.00
Ash,	3.28	9.43
Nitrogen,	1.91	1.97

Hen Manure.

	Per Cent. Dried.	Per Cent. Fresh.
Moisture at 100° C.,	8.35	45.73
Calcium oxide,	2.22	.97
Magnesium oxide,	.62	–
Potassium oxide,	9.94	.18
Phosphoric acid,	2.02	.47
Nitrogen in organic matter,	1.85	.79
Nitrogen as ammoniates,	.28	
Insoluble matter,	34.65	39.32

Poudrette.

	Per cent.
Moisture at 100° C.,	5.25
Ash,	35.45
Potassium oxide,	49
Phosphoric acid,	5.74
Nitrogen,	3.58
Insoluble matter,	4.65

Miscellaneous.

	Per Cent. Soot.	Per Cent. Ashes from Blue Works.
Moisture at 100° C.,	5.54	12.74
Organic and volatile matter,	22.90	36.22
Magnesium oxide,	–	Trace.
Potassium oxide,	1.83	9.02
Cyanogen compounds,	–	Trace.
Insoluble matter,	35.34	12.30

COMPILATION OF ANALYSES OF FODDER ARTICLES, FRUITS AND SUGAR-PRODUCING PLANTS, ETC.,

MADE AT

AMHERST, MASS.

1868–1889.

Prepared by MR. W. H. BEAL.

A. ANALYSES OF FODDER ARTICLES.

B. ANALYSES OF FODDER ARTICLES WITH REFERENCE TO FERTILIZING INGREDIENTS.

C. ANALYSES OF FRUITS.

D. ANALYSES OF SUGAR-PRODUCING PLANTS.

A. — *Analyses of Fodder Articles.*

NAME.	Analyses.	Dry Matter.			100 Parts of Dry Matter contained — Protein.			Fat.			Nitrogen — Free Extract.			Fibre.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
I. Green Fodders.																		
Fodder corn,	10	29.73	11.39	20.65	17.19	8.36	11.43	3.38	1.81	2.59	63.05	42.02	55.70	27.29	20.93	24.56	5.43	1 : 7.18
Fodder corn (ensilaged),	12	28.40	13.12	20.34	12.58	6.91	8.70	6.07	3.15	3.89	65.69	42.99	56.93	35.25	17.67	25.36	5.21	1 : 9.98
Whole ears (ensilaged),	1	-	-	49.73	-	-	6.63	-	-	7.84	-	-	75.68	-	-	8.50	1.35	-
Green oats,	2	28.82	21.39	25.11	7.10	7.05	7.08	2.44	2.02	2.23	50.69	50.38	50.54	33.12	32.83	32.97	7.19	1 : 13.14
Herds-grass (timothy),	2	35.00	34.26	34.63	8.83	8.20	8.52	2.07	1.95	2.01	51.33	51.23	51.28	33.23	32.50	32.87	5.33	1 : 10.84
Hungarian grass,	1	-	-	25.93	-	-	9.38	-	-	1.01	-	-	57.80	-	-	24.67	7.15	1 : 6.86
Vetch and oats { 9 parts oats / 1 part vetch }	2	24.04	13.89	18.97	10.76	10.59	10.68	2.74	2.29	2.52	43.75	40.10	41.98	35.81	34.20	35.01	9.88	1 : 7.04
Horse bean,	1	-	-	15.17	-	-	16.68	-	-	2.31	-	-	47.09	-	-	28.17	5.75	1 : 2.71
Cow-pea,	1	-	-	19.55	-	-	17.93	-	-	2.62	-	-	46.13	-	-	25.88	7.44	1 : 11.71
White lupine,	1	-	-	14.65	-	-	18.71	-	-	2.41	-	-	42.67	-	-	31.18	5.03	-
Serradella,	1	-	-	15.40	-	-	17.75	-	-	2.65	-	-	41.54	-	-	26.21	11.85	1 : 4.07
II. Hay and Dry Coarse Fodders.																		
Fodder corn,	3	93.35	91.17	92.62	8.63	6.17	7.21	2.06	1.11	1.53	55.68	53.86	54.98	33.75	29.05	31.40	4.88	1 : 11.85
Corn stover,	6	93.05	75.00	83.73	12.15	6.47	8.21	2.68	1.27	2.09	68.05	48.82	54.65	36.10	20.93	30.41	4.66	1 : 10.43
Oats (in blossom),	1	-	-	93.57	-	-	6.58	-	-	2.92	-	-	50.03	-	-	34.06	6.41	1 : 14.23

Oats (seed in milk),	1	–	–	90.45	–	–	10.89	–	–	2.69	–	–	46.02	–	–	34.32	6.08	1:7.90
Oats (ripe),	1	–	–	91.30	–	–	6.05	–	–	2.61	–	–	48.92	–	–	36.31	6.11	1:15.03
Winter rye,	1	–	–	91.45	–	–	10.66	–	–	2.57	–	–	47.40	–	–	32.97	6.40	1:8.28
Barley (seed in milk),	1	–	–	89.75	–	–	10.26	–	–	2.76	–	–	52.91	–	–	29.12	4.95	1:9.59
Wheat straw,	1	–	–	93.80	–	–	7.20	–	–	1.63	–	–	50.46	–	–	35.91	4.80	1:8.00
Millet,	5	93.85	91.90	93.00	8.11	7.09	7.59	2.67	.89	1.74	55.80	49.62	51.63	35.91	29.80	33.54	5.49	1:7.78
English hay,	3	91.70	89.22	90.12	9.75	8.75	9.12	2.65	2.55	2.61	54.43	45.96	50.59	35.55	29.21	31.65	5.97	1:10.24
Rowen (field-cured),	2	91.16	80.29	85.73	14.70	13.20	13.95	4.96	3.05	4.01	43.79	41.92	42.86	29.46	29.43	29.45	9.75	1:6.12
Rowen, ensilaged (air-dry),	1	–	–	81.56	–	–	12.34	–	–	6.98	–	–	43.99	–	–	27.93	8.76	–
Herds-grass (timothy),	4	92.76	89.45	91.43	9.02	7.24	8.32	2.65	1.95	2.20	54.43	50.01	51.75	36.59	29.21	32.90	4.85	1:11.44
Red-top,	4	93.19	91.76	92.30	8.40	6.41	7.88	1.69	1.50	1.60	54.74	50.32	52.67	34.11	31.12	32.92	4.97	1:12.06
Orchard grass,	4	91.62	90.86	91.17	11.29	7.57	8.99	3.56	2.40	2.91	47.34	43.50	46.15	35.79	34.12	34.89	7.05	1:10.47
Meadow fescue,	2	92.60	91.97	92.21	7.27	7.02	7.15	2.17	1.78	1.98	49.18	48.16	48.67	34.61	34.46	34.54	7.68	1:12.98
Barn-yard grass,	1	–	–	93.35	–	–	15.27	–	–	1.95	–	–	38.24	–	–	33.72	10.82	1:2.94
Hungarian grass,	1	–	–	92.55	–	–	9.45	–	–	2.22	–	–	50.64	–	–	31.96	5.73	1:6.22
White daisy,	1	–	–	90.35	–	–	7.68	–	–	2.32	–	–	46.86	–	–	36.09	7.05	–
Lucerne (alfalfa),	3	91.67	84.00	89.09	16.34	11.12	13.47	2.50	1.54	2.03	51.62	45.29	48.74	28.54	25.42	27.27	8.49	1:4.30
Sand lucerne,	1	–	–	91.20	–	–	16.26	–	–	2.59	–	–	50.31	–	–	21.27	9.57	1:3.50
Alsike clover,	2	91.70	91.36	91.53	17.32	14.97	16.15	3.26	2.89	3.08	44.94	44.63	44.79	26.28	21.44	23.86	12.14	1:4.96
Cow-pea,	3	90.70	90.25	90.43	17.17	16.95	17.05	4.49	3.81	4.06	51.41	46.06	47.94	23.58	19.06	21.67	9.29	1:4.82
Serradella,	2	92.80	91.30	92.05	17.85	15.26	16.56	2.91	2.37	2.64	50.23	49.54	49.89	25.14	24.37	24.76	6.17	1:4.97
Vetch,	2	91.65	90.55	91.10	15.76	14.42	15.09	2.69	2.30	2.50	44.34	43.29	43.82	30.68	30.05	30.37	8.24	1:3.87
Horse-bean straw,	1	–	–	90.85	–	–	9.69	–	–	1.51	–	–	37.77	–	–	41.44	9.59	1:8.55

A.—*Analyses of Fodder Articles*—Concluded.

NAME.	Analyses.	Dry Matter.			100 Parts of Dry Matter contained—													Nutritive Ratio (Average).
					Protein.			Fat.			Nitrogen—free extract.			Fibre.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
III. Roots, Bulbs, Tubers, etc.																		
Beets, red,	4	14.51	13.05	13.92	12.17	7.82	10.47	1.76	.79	1.06	79.33	70.98	74.29	6.23	4.29	5.13	8.56	–
Beets, sugar,	[illegible]	19.53	14.01	16.48	17.44	7.32	11.63	.83	.39	.62	81.39	72.79	75.70	6.98	5.27	6.17	4.33	1:9.12
Mangolds,	3	13.08	11.73	12.25	12.84	7.83	10.37	1.01	.73	.88	73.38	70.32	71.78	9.54	7.08	7.94	9.06	1:10.07
Ruta-bagas,	2	12.77	11.60	12.19	11.16	10.34	10.75	2.32	1.23	1.78	68.58	65.68	67.13	11.60	11.03	11.32	9.03	1:12.29
Turnips,	2	12.80	8.23	10.52	10.81	9.67	10.24	1.74	1.42	1.58	70.62	68.80	69.71	10.96	10.12	10.54	7.93	1:13.07
Carrots,	2	12.52	9.98	11.25	9.63	8.90	9.27	3.94	1.89	2.92	73.96	67.24	70.60	10.76	7.55	9.16	8.07	1:9.39
Potatoes,	[illegible]	21.95	13.91	18.78	13.56	9.58	10.48	.83	.27	.51	81.74	78.80	80.76	3.55	1.91	2.85	5.41	1:11.64
Apples,	2	24.83	19.68	22.26	4.57	3.92	4.25	2.81	1.71	2.26	86.21	83.44	84.33	7.05	6.14	6.60	2.08	1:26.44
IV. Grains and other Seeds.																		
Corn kernels,	21	91.98	87.90	89.55	15.02	8.80	12.75	9.43	4.25	5.62	82.64	71.06	77.85	3.38	1.86	2.42	1.70	1:8.50
Corn kernels and cobs,	8	90.55	73.66	85.12	15.06	7.82	11.13	5.27	3.36	4.24	80.87	70.13	75.63	9.77	5.30	7.34	1.67	1:8.63
Wheat, grain,	1	–	–	89.42	–	–	13.35	–	–	1.79	–	–	80.26	–	–	2.42	2.18	1:6.42
Broom-corn seed,	1	–	–	85.90	–	–	11.21	–	–	4.05	–	–	74.05	–	–	8.34	2.35	–
Horse beans,	1	–	–	89.72	–	–	30.03	–	–	1.11	–	–	56.48	–	–	8.11	4.27	1:2.24

V. Flour and Meal.																			
Corn meal,	17	89.29	82.96	87.14	16.08	10.07	11.30	5.74	3.10	4.46	83.24	73.20	79.87	3.92	1.56	2.73	1.65	1:8.79
Hominy meal,	3	91.89	89.30	90.75	11.88	11.20	11.61	12.22	4.89	9.33	78.07	68.00	72.27	4.78	3.69	4.08	2.71	1:8.82
Broom-corn meal,	1	-	-	86.46	-	-	11.14	-	-	4.13	-	-	74.30	-	-	8.00	2.43	-
VI. By-Products and Refuse.																			
Cotton-seed meal,	7	93.16	90.11	91.92	47.04	18.17	42.22	14.72	5.22	13.48	54.55	25.03	27.89	14.80	6.28	8.22	8.06	1:1.45
Cotton hulls,	2	89.83	88.55	89.19	5.36	4.90	5.13	4.27	2.36	3.51	46.75	38.59	42.67	51.40	40.24	45.82	3.07	-
Wheat bran,	12	90.75	86.30	89.03	20.24	15.67	17.79	6.08	2.80	4.61	62.18	56.89	59.58	14.26	7.60	11.18	6.84	1:3.78
Wheat middlings,	3	90.75	89.45	90.45	19.21	17.23	18.21	6.46	3.19	4.63	74.30	61.62	69.52	8.40	1.40	4.11	3.45	1:4.10
Rye bran,	2	91.82	86.30	89.06	18.98	16.52	17.75	3.03	2.07	2.55	73.56	69.24	71.40	4.54	3.46	4.00	4.30	1:4.88
Rye middlings,	1	-	-	87.46	-	-	13.15	-	-	5.61	-	-	73.52	-	-	3.70	4.02	1:7.28
Gluten meal,	11	91.57	88.32	90.39	39.28	28.24	32.07	9.34	3.92	6.71	66.26	48.84	59.68	4.74	.27	1.16	.38	1:2.54
Refuse from starch works,	1	-	-	42.96	-	-	22.41	-	-	10.17	-	-	58.98	-	-	7.54	.90	-
Spent brewers' grain,	1	-	-	93.02	-	-	20.49	-	-	1.95	-	-	55.51	-	-	15.90	6.15	-
Linseed cake,	1	-	-	91.65	-	-	37.25	-	-	5.69	-	-	40.85	-	-	8.69	7.52	1:1.62
Pea meal,	1	-	-	91.15	-	-	20.95	-	-	1.67	-	-	55.02	-	-	19.42	2.94	1:2.07
Broom-corn waste,	1	-	-	91.30	-	-	6.78	-	-	1.00	-	-	48.09	-	-	39.25	4.88	-
Cocoa dust,	1	-	-	92.90	-	-	15.47	-	-	25.85	-	-	45.99	-	-	5.86	6.83	-
Apple pomace,	2	21.78	17.22	19.50	7.73	6.94	7.34	4.37	3.17	3.78	72.93	70.20	71.57	16.58	13.15	14.86	1.46	-
Apple pomace (ensilage),	1	-	-	14.67	-	-	8.22	-	-	7.36	-	-	58.03	-	-	22.18	4.21	-
Sugar-beet pulp,	1	-	-	10.32	-	-	12.41	-	-	.95	-	-	61.86	-	-	23.74	1.04	1:7.10
Corn cobs,	4	-	-	90.00	4.15	3.00	3.57	.67	.38	.57	63.62	60.58	61.79	33.77	31.36	32.93	1.21	1:30.85

B.—*Analyses of Fodder Articles with Reference to Fertilizing Ingredients.*

NAME.	Number of Analyses.	Moisture.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Nitrogen.	Insoluble Matter.	Valuation per ton of 2,000 lbs.
I. GREEN FODDERS.												
Fodder corn,	3	71.96	4.84	.52	.08	.24	.09	.03	.21	.64	.57	$3.76
Fodder corn (ensilaged),	1	71.60	–	.33	.05	.10	.09	.02	.14	.36	.04	1.68
Vetch and oats,	1	86.11	1.72	.79	.03	.09	.03	.01	.09	.23	.33	1.58
Cow-pea,	2	79.63	1.77	.45	.06	.44	.12	.01	.11	.42	.11	1.94
Serradella,	2	82.59	1.82	.42	.09	.46	.67	.02	.14	.41	.10	1.92
White lupine,	1	85.35	.74	1.73	.68	3.07	.73	.17	.35	.44	.90	3.39
Horse bean (whole plant),	1	74.71	–	1.37	.09	1.37	.62	.20	.33	.68	2.04	3.87
II. HAY AND DRY COARSE FODDER.												
Fodder corn,	5	–	4.91	.76	.10	.60	.69	.07	.51	1.80	1.65	7.38
Corn stover,	1	24.87	3.86	1.47	.79	.31	.09	.03	.20	1.00	1.32	4.89
Rowen,	1	8.84	9.57	2.86	.12	.85	.20	.06	.36	1.93	2.18	9.50
Herds-grass (timothy),	2	7.52	4.93	1.53	.22	.71	.10	–	.46	2.26	1.17	5.42
Red-top,	4	7.71	4.59	1.02	.44	.57	.13	.04	.36	1.15	1.74	5.21
Orchard grass,	4	8.84	6.42	1.88	.23	.46	.30	.03	.41	1.31	2.66	6.54

Meadow fescue,	2	7.71	7.08	2.00	.11	.50	.14	.03	.23	1.05	1.68	5.55
White daisy,	1	9.65	6.37	1.25	.16	1.30	.20	.03	.44	.28	1.11	2.54
Lucerne (alfalfa),	2	8.37	6.82	1.46	1.08	2.02	.42	.10	.45	1.76	.70	7.76
Alsike clover,	2	8.47	11.11	2.17	.40	1.74	.67	.33	.80	2.36	3.23	10.82
Serradella,	1	10.54	10.60	.26	.55	2.63	.39	-	.90	2.54	.21	11.93
Vetch and oats,	1	11.42	10.96	.50	.20	.56	.19	.08	.60	1.50	2.12	6.25
III. ROOTS, BULBS, TUBERS, ETC.												
Beets, red,	4	86.08	1.13	.45	.08	.05	.04	-	.10	.24	.03	1.32
Beets, sugar,	2	84.65	.80	.22	.15	.12	.09	.02	.08	.25	.07	1.14
Mangolds,	2	87.29	1.22	.38	.13	.06	.04	.01	.09	.19	.03	1.08
Ruta-bagas,	2	87.82	1.10	.50	.10	.09	.03	-	.13	.21	.01	1.30
Turnips,	1	87.20	1.01	.41	.13	.12	.03	.01	.12	.22	.07	1.22
Carrots,	1	90.02	-	.07	.11	.54	.02	.01	.10	.14	.01	1.06
Apples,	2	79.91	.41	.19	.03	.03	.03	-	.01	.13	-	.61
IV. GRAINS AND OTHER SEEDS.												
Corn kernels,	8	10.88	-	.44	.04	.02	.21	.01	.73	1.93	.02	7.81
Corn and cob,	4	10.00	1.45	.44	.12	.66	.16	-	.60	1.46	.09	6.05
V. FLOUR AND MEAL.												
Wheat meal,	1	9.83	1.22	.17	.11	.54	.05	-	.57	2.21	-	8.65
Hominy feed,	1	8.93	1.89	.18	-	.49	.28	-	.98	1.63	-	6.14

B. — *Analyses of Fodder Articles with Reference to Fertilizing Constituents* — Continued.

NAME.	Number of Analyses.	Moisture.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Nitrogen.	Insoluble Matter.	Valuation per ton of 2,000 lbs.
VI. BY-PRODUCTS AND REFUSE.												
Cotton-seed meal,	5	8.34	6.27	1.54	.17	.78	1.08	–	1.87	4.77	.58	$19.77
Cotton hulls,	3	10.13	2.61	1.08	–	.18	.26	–	.20	.75	.06	3.74
Wheat bran,	4	11.01	6.44	1.62	.18	.20	.90	.02	2.87	2.88	.13	14.61
Wheat middlings,	1	9.18	2.30	.63	.11	.20	.21	–	.95	2.63	–	10.63
Rye middlings,	1	12.54	3.52	.81	.03	.09	.32	.02	1.26	1.84	.17	8.46
Gluten meal,	3	8.75	.65	.05	.02	.03	–	.05	.40	5.21	–	18.23
Spent brewers' grain,	1	6.98	6.15	.30	.35	1.55	.29	.16	1.26	3.05	1.77	12.14
Linseed cake,	1	8.35	6.89	1.43	–	.64	.77	–	1.86	5.46	–	22.01
Pea meal,	1	8.85	–	.99	.62	.30	.30	.03	.82	3.08	.12	11.31
Broom-corn waste,	1	10.37	4.70	1.86	–	.24	.17	–	.46	.87	1.00	5.09
Cocoa dust,	1	7.10	6.35	2.11	–	.63	–	–	1.34	2.30	–	11.22
Apple pomace,	2	80.50	.27	.13	.03	.04	.03	.01	.02	.23	.01	.91

NOTE. — Basis of valuation, nitrogen 17 cents, phosphoric acid 6 cents, potassium oxide $4\frac{1}{4}$ cents per pound.

C.—*Analyses of Fruits.*

NAME.	Date.	Dry Matter.	Specific Gravity of Juice.	Temperature C. of Juice (Degrees).	Total Sugar in Juice.	Grape Sugar in Juice.	Cane Sugar in Juice.	* Soda Sol. required to neutralize 100 pts. Juice.
	1877.	Per ct.			Per ct.	Per ct.	Per ct.	C. C.
Apple (Baldwin), ...	Sept. 1,	20.14	1.055	12–15	3.09	–	–	–
" "	Oct. 9,	19.66	1.065	" "	6.25	–	–	–
" "	Nov. 27,	–	1.075	" "	10.42	–	–	–
Rhode Island Greening, . .	Sept. 1,	20.27	1.055	" "	3.16	–	–	–
" " " . .	Oct. 9,	19.68	1.066	" "	7.14	–	–	–
" " " † . .	Nov. 27,	20.25	1.080	" "	11.36	–	–	–
Pear (Bartlett), ...	Aug. 31,	15.00	1.060	" "	4.77	–	–	–
" "	Sept. 7,	16.55	1.060	" "	5.68	–	–	–
" "	Sept. 20,	–	1.065	" "	8.62	–	–	–
" " ‡.	Sept. 22,	–	1.060	" "	8.93	–	–	–
Cranberries, ...		10.71	1.025	15	1.35	–	–	–§
"	1878.	10.11	1.025	15	1.70	–	–	–‖
Early York Peach (ripe), . .	–	–	1.045	25	–	1.92	6.09	45
" " " (nearly ripe),	–	10.96¶	1.039	25	–	1.36	4.12	42.3
Crawford Peach (nearly ripe),	–	–	1.050	18	–	2.19	7.02	85.6
" " (mellow), .	–	11.36¶	1.055	18	–	1.70	8.94	76
" " (not mellow),	–	11.88¶	1.045	22	–	1.67	5.92	64

* One part Na_2CO_3 in 100 parts of water.
† Picked October 9.
‡ Picked September 7.
§ Free acid, 2.25 per cent.
‖ Free acid, 2.43 per cent.
¶ In pulp, kept ten days before testing.

C.—*Analyses of Fruits*—Continued.

Wild and Cultivated Grapes.

NAME.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter.	Grape Sugar in Juice.	Sugar in Dry Matter.	* Soda Sol. required to neutralize 100 pts. of Juice.
	1876.			Per ct.	Per ct.	Per ct.	C. C.
Concord,	July 17,	1.0175	31	8.30	.645	7.77	–
"	July 20,	1.0150	31	8.10	.625	7.72	216
"	Aug. 2,	1.0200	25	9.94	.938	9.44	249
"	Aug. 16,	1.0250	28	10.88	2.000	18.38	229
"	Aug. 30,	1.0500	25	15.58	8.620	55.33	120
"	Sept. 13,	1.0670	23	17.48	13.890	79.46	55
"	Sept. 4,	1.0700	18	19.82	16.130	81.38	49.2
Purple Wild Grape,	July 19,	1.020	31	9.00	.714	7.93	204
" " "	Aug. 4,	1.020	28	12.25	1.100	8.98	249
" " "	Aug. 16,	1.025	28	12.48	2.000	16.03	233
" " "	Aug. 30,	1.050	26	16.58	6.500	39.81	147.6
White Wild Grape,	Aug. 31,	1.050	26	16.48	9.260	56.18	98
Hartford Prolific,	Sept. 5,	1.060	22	17.39	13.89	79.87	88.8
Ives' Seedling,	Sept. 6,	1.070	26	20.15	15.15	75.14	88.6
Iona,	Sept. 7,	1.080	21	24.56	15.15	61.68	144
" (mildewed),	Sept. 7,	1.045	26	15.41	6.25	40.56	204.4
Agawam,	Sept. 11,	1.075	20	20.79	17.24	82.92	94.8
Wilder,	Sept. 11,	1.064	20	16.53	13.67	82.69	56
Delaware,	Sept. 12,	1.080	24	23.47	17.86	76.09	74
Charter Oak,	Sept. 12,	1.080	24	15.98	8.77	54.94	168.3
Israella,	Sept. 16,	1.075	23	19.67	9.20	46.77	89.8
Bent's Seedling,	Sept. 20,	1.080	21	20.65	16.13	78.11	181.8
Adirondack,	Sept. 20,	1.065	21	15.11	13.17	87.16	68
Catawba,	Oct. 16,	1.080	13	23.45	17.39	74.16	82
	1877.						
Wilder,	Sept. 11,	1.065	23	16 41	15.15	92.32	60
Charter Oak,	Sept. 12,	1.055	23	16.22	9.80	60.42	96
Concord,	Sept. 13,	1.065	24	15.90	13.16	82.76	102
"	Sept. 26,	1.075	24	19.34	15.43	79 78	70.8
Eumalan,	Sept. 24,	1.065	16	19.62	13.16	67.07	73
Wild White Grape,	Sept. 5,	1.050	22	15.57	7.20	46.24	140.8
" " " (shrivelled),	Sept. 20,	1.060	16	20.02	10.00	49.95	130
Wild Purple Grape (shrivelled),	Sept. 20,	1.045	16	16.69	8.22	49.25	104

* One part of pure $Na_2\ CO_3$ in 100 parts water.

C. — *Analyses of Fruits* — Continued.

Effect of Girdling on Grapes.

NAME AND CONDITION.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter at 100° C.	Grape Sugar in Juice.	Sugar in Dry Matter.	* Soda Sol. required to neutralize 100 parts of Juice.
	1877.			Per ct.	Per ct.	Per ct.	C. C.
Hartford Prolific, not girdled, . .	Sept. 3,	1.045	19	12.85	8.77	68.25	111.4
" " girdled, . . .	Sept. 3,	1.065	19	17.18	12.50	72.76	100
Wilder, not girdled, ...	Sept. 3,	1.055	19	15.41	10.42	67.62	108.2
" girdled, ...	Sept. 3,	1.075	19	17.24	14.70	85.26	88.4
Delaware, not girdled, ...	Sept. 4,	1.065	19	15.75	11.76	74.66	101.2
" girdled, ...	Sept. 4,	1.075	19	19.14	15.15	79.16	94.4
Agawam, not girdled, ...	Sept. 4,	1.060	19	16.60	11.37	68.48	128.2
" girdled, ...	Sept. 4,	1.075	19	18.45	16.31	87.42	114.8
Iona, not girdled, ...	Sept. 6,	1.0625	22	16.60	13.51	68.31	131.4
" girdled, ...	Sept. 6,	1.085	22	21.48	15.63	72.76	125.6
Concord, not girdled, ...	Sept. 6,	1.045	22	13.46	7.46	55.42	182.4
" girdled, ...	Sept. 6,	1.070	22	17.53	13.88	79.18	102.8
" not girdled, ...	Sept. 26,	1.065	22	17.63	13.70	78.27	86
" girdled, ...	Sept. 26,	1.080	22	24.47	19.61	80.13	76.8
" not girdled, ...	Oct. 5,	1.075	12	20.92	17.50	85.37	42
" girdled, ...	Oct. 5,	1.085	12	–	17.86	–	54

* One part of Na_2CO_3 in 100 parts of water.

C. — *Analyses of Fruits* — Continued.

Effect of Fertilization upon the Organic Constituents of Wild Grapes.

NAME.	Date.	Dry Matter.	Specific Gravity.	Temperature C. (Degrees).	Per cent. of Grape Sugar.	Per cent. of Acids.	Remarks.
	1877.						
Wild Purple Grape Berries, .	Sept. 20,	16.31	–	–	8.03	–	Unfertilized.
" " " " . .	"	19.55	–	–	13.51	–	Fertilized.
" " " Juice, . .	"	–	1.045	16	8.22	9.840	Unfertilized.
" " " " . .	"	–	1.065	16	13.51	1.149	Fertilized.
Wild White Grape Berries, . .	"	20.02	–	–	–	–	Unfertilized.
" " " " . .	"	21.65	–	–	–	–	Fertilized.
" " " Juice, . .	"	–	1.060	16	10.00	1.846	Unfertilized.
" " " " . .	"	–	–	–	14.29	.923	Fertilized.

Effect of Fertilization upon the Ash Constituents of Grapes.

NAME.	Date.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Remarks.
	1876.								
Wild Purple Grapes,	Sept. 13,	50.93	.15	22.23	5.59	.79	17.40	2.93	Unfertilized.
" " "	Sept. 20,	62.65	.85	14.24	3.92	.53	13.18	4.63	Fertilized.
Concord Grapes, .	July 7,	41.73	5.04	25.03	7.80	.55	18.48	1.37	Unfertilized.
" " .	July 17,	47.34	1.13	24.21	–	.75	21.38	.43	"
" " .	Aug. 18,	51.14	3.19	16.20	6.38	.65	20.77	1.67	"
" " .	Sept. 13,	57.15	4.17	11.30	3.10	.40	12.47	11.82	"
	1878.								
" " .	Oct. 3,	64.65	1.42	9.13	3.63	.50	14.87	5.80	Fertilized.

C.— *Analyses of Fruits* — Concluded.

Ash Analyses of Fruits and Garden Crops.

	Ash.	100 Parts of Ash contained—						
		Potash.	Soda.	Lime.	Magnesia.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.
Concord grape (fruit),	–	51.14	3.19	16.20	6.38	.65	20.77	1.67
Unfermented juice,	–	50.85	.48	3.69	4.25	.10	6.43	.90
Fermented juice,	–	40.69	–	6.85	6.24	–	9.04	–
Skins and pulp,	–	7.70	.42	57.36	8.80	.08	24.40	1.32
Seeds,	3.08	6.71	–	–	3.03	–	17.20	.29
Stems of grapes,	4.69	20.91	–	20.20	8.45	–	17.75	2.09
Young branches, *	–	24.71	.94	40.53	10.66	1.08	17.16	4.92
Wood of vine,†	2.97	22.57	–	9.72	4.28	–	14.07	23.84
Clinton grape (fruit),	–	58.45	3.51	13.34	7.37	.90	18.19	–
Baldwin apple,	–	63.54	1.71	7.28	5.52	1.08	20.87	3.68
Strawberry (fruit),‡	.52	49.24	3.23	13.47	8.12	1.74	18.50	5.66
" " §	–	58.47	–	14.64	6.12	3.37	17.40	–
" vines,	3.34	10.62	13.35	36.63	3.83	6.91	14.48	14.17
Cranberry (fruit),	.18	47.96	6.58	18.58	6.78	–	14.27	–
" vines,	2.45	12.98	3.27	16.49	10.33	3.35	10.94	34.04
Currants, red,	.47	47.68	4.02	18.96	6.23	1.20	21.91	–
" white,	.59	52.79	3.00	17.08	5.68	2.67	18.78	–
Crawford peach, sound,	–	74.46	–	2.64	6.29	.58	16.02	–
" " diseased,‖	–	71.30	–	4.68	5.49	.46	18.07	–
Branch, sound,	–	26.01	–	54.52	7.58	.52	11.37	–
" diseased, ‖	–	15.67	–	64.23	10.28	1.45	8.37	–
Asparagus stems,	–	42.94	3.58	27.18	12.77	1.22	12.31	.08
" roots,	–	56.43	5.42	15.48	7.57	–	15.09	3.67
Onions,	–	38.51	1.90	8.20	3.65	.58	15.80	3.33

* With tendrils and blossoms. † One year old. ‡ Wilder. § Downing. ‖ Yellows.

D. — *Analyses of Sugar-producing Plants.*

Composition of Sugar Beets raised upon the college grounds during the season of 1870 and 1871.

NAME.	Date.	Brix Saccharo-meter (Degrees).	Per cent. of Sugar.	Non-saccharine Substances.
Electoral, ...	Sept. 10,	14	12.30	1.75
Imperial, ...	" 12,	15	12.59	2.41
Vilmorin, ...	" 13,	14.5	12.95	1.55
Imperial, ...	" 18,	14	10.79	3.21
Imperial, ...	Oct. 11,	15	12.05	2.95
Electoral, ...	" 16,	15	12.22	2.78
Vilmorin, ...	" 18,	16	13.13	2.87
Imperial, ...	Nov. 14,	15	11.60	3.34
Vilmorin, ...	" 21,	15.5	13.12	2.38
Vienna Globe,*	Sept. 19,	11	8.00	3.00
Common Mangold,* . . .	" 19,	9	5.00	3.97

* Fodder beets.

Percentage of Sugar in Different Varieties of Sugar Beets grown on college farm during the season of 1882.

NAME.	Source of Seed.	Weight in Pounds.	Per cent. of Sugar in Juice.
I. Vilmorin, ...	Saxony, .	$\frac{3}{4}$ to $\frac{7}{8}$	15.50
II. "	"	$\frac{3}{4}$ to 1	15.61
I. White Imperial, ...	"	$\frac{3}{4}$ to $1\frac{3}{4}$	14.20
II. " "	"	$1\frac{3}{4}$ to 2	10.27
New Imperial, ...	"	$1\frac{1}{4}$ to $1\frac{3}{4}$	13.80
I. White Magdeburg, . . .	"	$1\frac{1}{2}$ to 2	13.10
II. " " . . .	Silesia, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	10.06
Quedlinburg, ...	Saxony, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	13.44
White Silesian, ...	Silesia, .	$1\frac{1}{4}$ to $1\frac{1}{2}$	9.72

D. — *Analyses of Sugar-producing Plants* — Continued.

Effect of Soil and Fertilization on Electoral Sugar Beets.*

Soil.	Manure.	Specific Gravity Brix (Degrees).	Per cent. of Sugar in Juice.	Non-saccharine Substances.	Cane Sugar in Soluble Matter.
Sandy loam, .	Fresh yard manure, .	16.5	12.50	4.00	75.08
Clayish loam, .	" " " .	15.5	11.05	4.45	71.30
Warm alluvial, .	Yard manure and chemicals, . . .	12.75	9.17	3.58	71.92
" " .	Fresh hog manure, .	13.5	9.53	3.97	70.06
Light sandy soil,	No manure, . . .	18.5	13.73	4.77	74.21
Alluvial soil, .	Brighton fish, . .	14.5	11.15	3.35	76.90
Heavy soil, .	Yard manure, . .	12.25	8.15	4.10	66.53
–	–	13.5	9.90	3.60	73.33

* Not raised on college farm.

Effect of Fertilization on Sugar Beets.*

Fertilizers.	Percentages of Sugar in Juice.		
	Freeport.	Electoral.	Vilmorin.
Fresh horse manure, ...	11.96	9.42	7.80
Blood guano without potash, . .	10.99	10.10	10.20
Blood guano with potash, . .	12.55	13.24	10.50
Kainite and superphosphates, . .	13.15	12.16	10.50
Sulphate of potash, ...	14.52	14.32	12.78
Second year after stable manure, .	13.49	12.78	12.19

* All were grown on the same soil, — sandy loam.

D. — *Analyses of Sugar-producing Plants* — Continued.

Effect of Different Modes of Cultivation on Electoral Sugar Beets.

Locality of Beet-field.	Brix Saccharometer (Degrees).	Per cent. of Cane Sugar.	Non-saccharine Substances.
Sing Sing, N. Y.,	11	7.80	3.20
Washington, N. Y.,	14	10.97	3.03
South Hartford, N. Y.,	15	11.70	3.30
Greenwich, N. Y.,	12	9.50	2.50
Frankfort, N. Y.,	13.5	11.00	2.50
Albion, N. Y.,*	18	15.10	2.90
" " †	14	9.70	4.30

* From beets weighing from 1½ to 2 lbs. † From beets weighing from 10 to 12 lbs.

D. — *Analyses of Sugar-producing Plants* — Continued.

Early Amber Cane.

DATE.	CONDITION OF CANE.	Brix Saccharometer (Degrees).	Temperature C. (Degrees).	Grape Sugar.	Cane Sugar.	Soda Sol. required to neutralize 100 pts. of Juice.	Solids.
1879.				Per ct.	Per ct.	C. C.	Per ct.
Aug. 15,	No flower stalks in sight,*	4.2	27	2 48	None	6.8	7.93
Aug. 16,	" " " " *	5.8	24	4.06	None	9.0	11.10
Aug. 20,	Flower stalks developed,*	7.9	24	3.47	2.15	7.0	13.00
Aug. 24,	Flowers open,*	8.7	23	3.70	3.00	4.0	14.07
Aug. 27,	Plants in full bloom,*	10.0	25	3.65	4.13	10.0	15.48
Aug. 30,	Seed forming,*	9.5	30	4.00	3.81	9.5	16.14
Sept. 2,	Seed in milk,*	10.7	27	3.85	4.41	9.5	15.85
Sept. 9,	Seeds still soft,*	12.1	22	3.21	6.86	9.5	26.13
Sept. 9,	Stripped on Sept. 2,*	12.8	22	3.77	6.81	9.5	26.75
Sept. 18,	Left on field without stripping,*	13.2	22	3.57	7.65	–	–
Sept. 18,	Tops removed,*	13.8	22	3.16	8.49	–	–
Sept. 18,	Tops and leaves removed on Sept. 9,*	11.5	22	3.16	5.85	–	–
Sept. 18,	Tops removed; left on field 9 days,*	12.8	22	10.00	.60	–	–
Sept. 21,	Juice from the above,*	13.0	21	–	–	–	–
Sept. 23,	" " " *	15.0	18	–	–	–	–
Sept. 25,	Left on field 3 weeks,†	19.8	21	11.91	6.27	–	–
Sept. 28,	" " " †	17.8	12	16.60	–	–	–
Oct. 4,	" " " †	16.1	17	8.62	6.16	12.0	–
Oct. 7,	Freshly cut. Ground with leaves,†	16.7	20	4.16	9.94	6.8	–
Oct. 8,	" " Stripped 2 weeks,†	12.8	17	5.16	5.27	7.0	–
Oct. 9,	" " " " †	18.4	17	7.57	–	10.6	–
Oct. 14,	Several weeks old,†	18.2	15	10.42	–	10.4	–
Oct. 18,	" " " †	15.1	23	7.57	–	–	–
Oct. 19,	" " " †	15.5	15	9.22	–	13.6	–
Oct. 22,	" " " †	16.2	16	8.30	–	–	–
Oct. 23,	" " " †	18.3	17	11.30	5.5	14.0	–
Oct. 24,	" " " †	16.6	15	8.63	–	9.0	–

* Raised on the college farm. † Raised by farmers in the vicinity of the college.

D. — *Analyses of Sugar-producing Plants* — Concluded.

Composition of the Juice of Corn Stalks and Melons.

VARIETY.	Specific Gravity.	Temperature C. (Degrees).	Grape Sugar in Juice.	Cane Sugar in Juice.	Solids.
			Per ct.	Per ct.	Per ct.
Northern corn, *	1.023	27	4.35	.28	15.18
Black Mexican sweet corn, †	1.048	27	2.06	7.02	17.44
Evergreen sweet corn, †	1.052	–	4.85	5.70	20.38
Common sweet corn, ‡	1.035	–	6.60	None.	–
Common yellow musk-melon, §	1.040	26	1.67	2.65	–
White-flesh water-melon,	1.025	18	2.91	2.16	–
Red-flesh water-melon,	1.025	22	3.57	2.18	–
" "	1.025	19	3.84	1.77	–
Nutmeg musk-melon, ‖	1.030	19	3.33	2.11	–
" " ¶	1.050	20	2.27	5.38	–
" " **	1.030	19	2.50	1.43	–

* Tassels appearing.
† Ears ready for the table.
‡ Kernels somewhat hard.
§ Fully ripe.
‖ Not ripe.
¶ Ripe.
** Over-ripe.

Dairy Products.

NAME.	Volatile Matter and Moisture at 100° C.	Ash.	Fat.	Casein.	Non-nitrogenous Extract.
Whole milk,	87.40	.70	4.00	3.20	4.70
Skim milk,	89.81	.80	.37	3.53	5.49
Buttermilk,	91.84	.80	.21	2.79	4.36
Whole milk cheese (Jersey),*	37.16	3.39	37.32	22.13	–
Whole milk cheese,*	35.83	3.14	34 34	26.69	–
Cheese from milk skimmed after 12 hours' standing,*	37.30	4.52	27.81	30.37	–
Cheese from milk skimmed after 24 hours' standing,*	42.24	2.35	23.42	31.99	–
Cheese from milk skimmed after 36 hours' standing,*	43.95	5.14	17.67	33.24	–
Cheese from milk skimmed after 48 hours' standing,*	45.41	3.88	15.77	34.94	–
Cheese from skim milk with addition of buttermilk,*	48.38	4.64	18.35	28.63	–
Genuine oleomargarine cheese,*	37.90	4.50	31.66	25.94	–

* From analyses made in 1875.

METEOROLOGY.

The meteorological observations of the past year have been a continuation of those of preceding years, being on the same general plan as recommended to voluntary observers of the United States Signal Service. Observations are made at 7 A.M., 2 P.M. and 9 P.M., and include observations of temperature, quantity and movements of the clouds, direction of the wind, the humidity of the air during the summer months, rain and snow fall, and of casual phenomena.

January opened with 4 inches of snow and good sleighing, which continued through the larger part of the month. On the 26th, a heavy snow-storm. At the close of the month the snow averaged about 18 inches. Quite a depth of snow remained on the ground until the thaw of the 20th of February. The snowfall for the month of February amounted to 9.5 inches. At the close of the month there were 6 inches on the ground.

From the 11th to the 16th of March occurred the severest storm of the season. This storm is recorded as giving 16 inches of snow, which amounted to 3.35 inches of water. The storm was accompanied by high winds. The comparatively warm weather which followed took the snow off rapidly. At the close of the month there were but 2 inches of snow on the ground. The last storm of the season occurred on April 10, with a record of 1.5 inches of snowfall.

The rainfall for the year amounted to 58.04 inches, or an average of 4.84 per month. According to the observations at Amherst, this is the heaviest since they were begun in 1836.

The average rainfall for the years 1836–1888 amounts to 44.34 inches. The smallest rainfall during this time was in

1864, 34.44 inches; this was preceded, however, by a rainfall of 56.19 inches in 1863, which is, next to 1888, the highest for the period.

The largest rainfall during any one month was 10.70 inches in September. This record for one month has been exceeded only five times during the period covered by the Amherst observations (1836–1889). The rainfall was pretty evenly distributed throughout the rest of the year.

The mean annual temperature for the year is 43.98°. The average for the period from 1837–88 is 46.81. The average for the year 1875 was 44.22, which is the lowest except for the year 1888. The highest average thus far for any year has been 49.47°, in 1878. January, 1888, was the coldest month since 1837, being 9.5 lower than the average for that period. The temperature for October has been lower but once, — 1841, — and for April and July but twice, since the records began. The temperature for June, August and November was the average for those months, while December shows a considerably higher mean. February, March, May and September were considerably below the average. The weather during the growing months was quite favorable to the grass crop, but corn suffered considerably from the wet weather. The latter was unfavorable for the curing of both these crops.

The last killing frost of the season occurred May 8; the first in the autumn, September 7. The average date of the first killing frost in this vicinity is September 20. Light frost occurred May 16 and September 6. Snow-squalls occurred October 9; the first snow-storm happened November 25. This snowfall, amounting to 5 inches, was the only appreciable one during the month. The snow disappeared quickly. In December there were two slight storms, amounting to less than 3 inches.

The prevailing direction of the wind for the year was N. W. It was north-west in January, February, March, April, June, July, August, September, October and December; south-west in May, and north-east in November.

The number of days when the sky was less than four-tenths covered by clouds, clear days, was 58; the greatest number, 9, being in January, and the fewest, 1, in August.

There were 97 "cloudy" days, or those when the sky was more than seven-tenths covered by clouds. March and October had 12 cloudy days each; April and July the fewest, 3 each. The remaining days were variable, being partly cloudy and partly fair.

The highest temperature of the year was 94.5°, occurring July 23; the lowest, —21.5°, occurring January 23. The maximum for the previous year, 1887, was 93.6°, on the 2d of July, and the minimum was —22.2°, on the 19th of January. The absolute range of temperature for 1888 was 116°, practically the same as for 1887, 1° less than for 1886.

Summary of Meteorological Observations, 1888.

	Temperature. Degrees Fahrenheit.											Relative Humidity. Per ct.				Precipitation. Inches.	
	7 A.M.	2 P.M.	9 P.M.	Mean.	Maximum.	Minimum.	Range.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	7 A.M.	2 P.M.	9 P.M.	Mean.	Depth of Water.	Date of Greatest Fall.
January,	11.0	18.6	12.9	13.78	28.9	—3.5	32.4	41.0	2d	—21.5	23d	-	-	-	-	3.87	1st
February,	16.1	28.7	22.1	22.05	36 9	.3	36.6	49.0	14th	—19.0	10th	-	-	-	-	3.94	20th
March,	22.2	32.5	26.3	26.82	41.9	18.8	23.1	49.0	21st	—3.0	19th	-	-	-	-	5.96	11th to 14th
April,	35.8	49.2	39.5	40.44	67.3	28.3	39.0	84.0	29th	15.0	9th	-	-	-	-	3.08	5th
May,	49.6	62.7	53.2	54.70	68.0	39.7	28.3	80.0	29th	26.0	3d	82.7	61 3	79.3	74.4	4.29	11th
June,	61.5	74.1	63.6	65.82	79.2	56.4	22.8	94.5	23d	38.0	2d	81.4	60.4	77.7	73.1	5.40	23d
July,	61.6	76.5	65.5	67.20	73.4	60.2	13.2	85.5	5th	46.0	14th, 18th	82.9	53.1	78.6	71.5	3.63	19th to 20th
August,	63.1	75.4	65.5	67.38	78.6	57.0	21.6	87.0	16th	42.0	23d	85.5	61.5	83.0	76.7	4.29	12th to 13th
September,	52.6	65.1	56.0	57.10	70.9	36.9	34.0	76.0	2d, 17th	25.0	30th	93.3	63.0	86.5	80.9	10.70	20th to 21st
October,	38.7	49.2	42.1	43.12	56.0	35.1	20.9	66.0	5th	26.0	11th	89.0	65.2	82.1	78.1	5.19	6th to 7th
November,	35.2	47.9	38.0	38.93	59.6	13.9	45.7	71.0	2d	5.7	23d	-	-	-	-	3.91	8th to 10th
December,	26.4	35 4	29.9	30.40	49.4	9.4	40.0	56.5	25th	3.5	14th	-	-	-	-	3.78	16th to 18th
Sums,	473.8	615.3	514.6	527.74	710.1	352.5	357.6	839.5	-	188.7	-	514.8	364.5	487.2	454.7	58.04	-
Means,	39.5	51.3	42.9	43.98	59.2	29.4	29.8	70.0	-	15.7	-	85.8	60.8	81.2	72.5	4.84	-

Miscellaneous Phenomena — Dates.

	Frost.	Snow.	Rain.	Thunder-storms.	Lunar Halos.
January, ...	–	4, 8, 10, 13, 17, 25, 26,	1, 15,	–	–
February, ...	–	4, 7, 10, 11, 18, 25,	4, 8, 20, 25,	–	24
March, ...	–	2, 11, 12, 13, 21, 26,	20, 21, 22, 26, 27, 28,	–	25
April, ...	4, 17, 23, 24, 25,	10,	1, 2, 5, 10, 12, 14, 18, 20,	5,	–
May, ...	3, 8, 16,	–	1, 5, 8, 10, 11, 12, 13, 14, 15, 16, 18, 28, 29,	14,	21
June, ...	–	–	6, 7, 14, 15, 20, 21, 23, 24, 26, 28, 30,	6, 14, 15, 21, 23, 24, 30	–
July, ...	–	–	1, 5, 9, 11, 19, 20, 27, 31,	1, 5, 11,	–
August, ...	–	–	4, 5, 6, 12, 13, 17, 21, 22,	4, 17,	18
September, . . .	6, 7, 29, 30,	–	1, 8, 12, 16, 17, 18, 20, 21, 26,	20, 21,	15
October, ...	1, 3, 4, 11, 15, 19, 22, 26, 30,	–	1, 2, 6, 7, 12, 13, 14, 16, 17, 19, 24, 27, 28,	–	–
November, . . .	13, 17, 21, 22, 23, 24,	25,	3, 8, 9, 10, 15, 16, 19, 26, 27, 29,	–	14
December, . . .	3, 7, 21, 22,	4, 9,	6, 11, 16, 17, 18, 27,	–	15

RECORD

Of the Average Temperature taken from Weather Records at Amherst, Mass., for three consecutive months, during the summer and winter beginning with the year 1836.

December, January, February.	Degrees F.	June, July, August.	Degrees F.
1836–37, . .	25.396	1837, . . .	69.130
1837–38, . .	26.386	1838, . . .	69.550
1838–39, . .	25.950	1839, . . .	70.180
1839–40, . .	20.626	1840, . . .	68.770
1840–41, . .	23.146	1841, . . .	69.230
1841–42, . .	28.516	1842, . . .	68.210
1842–43, . .	23.460	1843, . . .	67.950
1843–44, . .	21.320	1844, . . .	67.260
1844–45, . .	25.550	1845, . . .	70.120
1845–46, . .	22.140	1846, . . .	68.406
1846–47, . .	25.176	1847, . . .	68.806
1847–48, . .	28.966	1848, . . .	69.210
1848–49, . .	23.026	1849, . . .	69.210
1849–50, . .	27.570	1850, . . .	68.820
1850–51, . .	25.040	1851, . . .	66.640
1851–52, . .	21.620	1852, . . .	66.830
1852–53, . .	27.940	1853, . . .	67.846
1853–54, . .	23.670	1854, . . .	69.856
1854–55, . .	23.126	1855, . . .	67.146
1855–56, . .	20.820	1856, . . .	69.225
1856–57, . .	22.720	1857, . . .	67.240
1857–58, . .	26.956	1858, . . .	67.930
1858–59, . .	24.746	1859, . . .	65.650
1859–60, . .	24.790	1860, . . .	66.540
1860–61, . .	24.510	1861, . . .	66.870
1861–62, . .	24.470	1862, . . .	66.490
1862–63, . .	27.640	1863, . . .	66.656
1863–64, . .	26.060	1864, . . .	69.336
1864–65, . .	21.310	1865, . . .	68.946
1865–66, . .	25.676	1866, . . .	67.400
1866–67, . .	25.276	1867, . . .	67.920

Record of Temperature, etc.—Concluded.

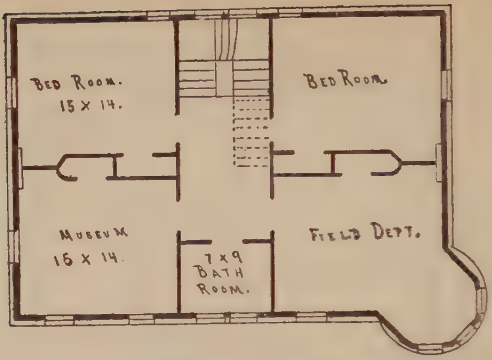
December, January, February.		June, July, August.	
	Degrees F.		Degrees F.
1867–68, . .	20.350	1868, . . .	69.700
1868–69, . .	26.290	1869, . . .	66.890
1869–70, . .	27.866	1870, . . .	71.700
1870–71, . .	26.666	1871, . . .	67.810
1871–72, . .	24.630	1872, . . .	70.790
1872–73, . .	21.350	1873, . . .	68.596
1873–74, . .	27.286	1874, . . .	66.306
1874–75, . .	21.180	1875, . . .	68.026
1875–76, . .	28.156	1876, . . .	71.780
1876–77, . .	23.510	1877, . . .	70.080
1877–78, . .	28.506	1878, . . .	68.896
1878–79, . .	24.290	1879, . . .	68.150
1879–80, . .	30.506	1880, . . .	69.286
1880–81, . .	21.856	1881, . . .	67.966
1881–82, . .	29.256	1882, . . .	69.866
1882–83, . .	24 220	1883, . . .	68.840
1883–84, . .	26.506	1884, . . .	68.960
1884–85, . .	22.630	1885, . . .	66.740
1885–86, . .	24.846	1886, . . .	66.100
1886–87, . .	22.146	1887, . . .	68.100
1887–88, . .	20.827	1888, . . .	67.893

JAMES P. LYNDE, *Treasurer, in Account with the* MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

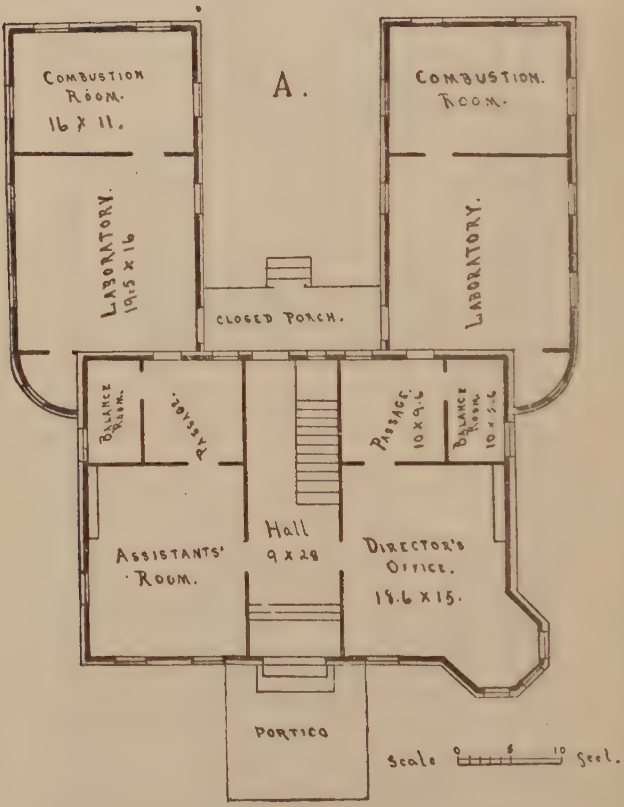
1888.	Received.		1888.	Expended.	
Jan. 1,	Cash balance in bank,	$263.11		Salaries,	$3,873.76
4,	State Treasurer,	2,500.00		Laboratory supplies,	747.61
11,	Dr. C. A. Goessmann, Director,	222.46		Printing and postage,	641.00
11,	Dr. C. A. Goessmann, Director,	176.27		Office expenses,	287.33
April 2,	State Treasurer,	2,500.00		Farmer and farm labor,	1,813.73
June 19,	Dr. C. A. Goessmann, Director,	99.62		Farm supplies,	533.34
July 5,	State Treasurer,	2,500.00		Stock,	95.00
Sept. 28,	State Treasurer,	2,500.00		Feed,	281.55
Oct. 13,	Dr. C. A. Goessmann, Director,	162 00		Miscellaneous expenses,	491.83
Nov. 6,	Dr. C. A. Goessmann, Director,	200.00		Construction and repairs,	2,935.84
Dec. 3,	Dr. C. A. Goessmann, Director,	10 00		Expenses Board of Control,	137.80
22,	Transferred from Hatch Funds,	705.33			
		$11,838.79			$11,838.79

Examined, compared with the vouchers, found correct, and approved. WM. R. SESSIONS, *Auditor*.

B.



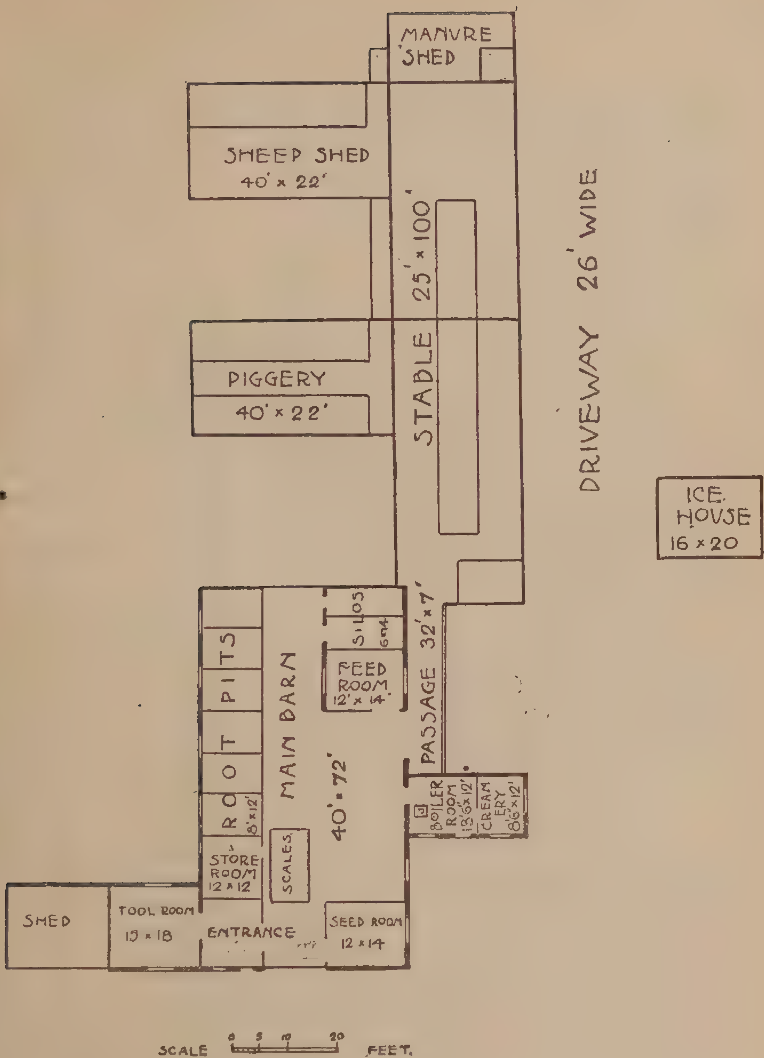
STATION BUILDING — 2nd FLOOR.



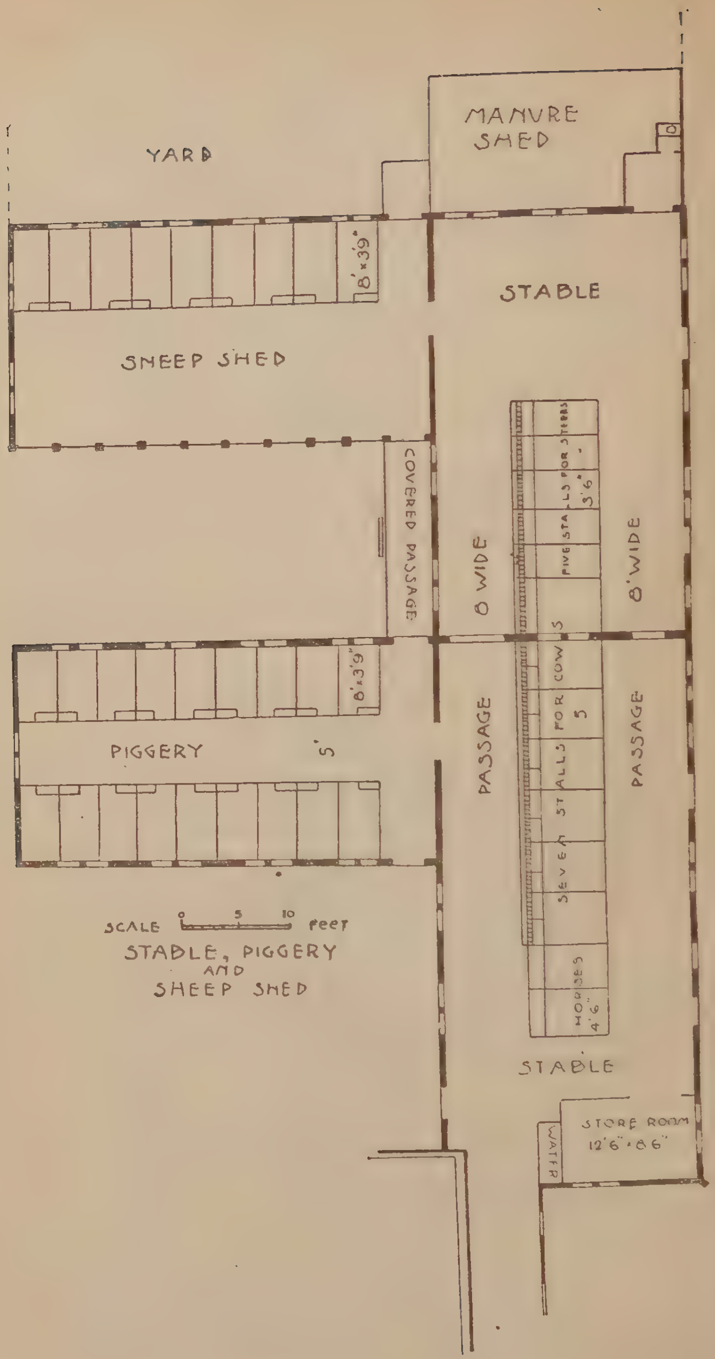
STATION BUILDING — GROUND PLAN.

A. LABORATORY BUILDING........ GROUND PLAN

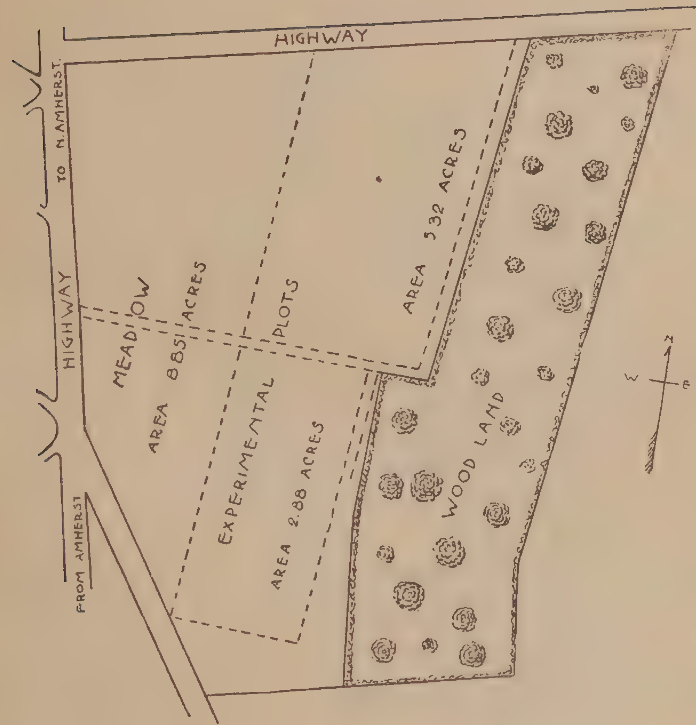
B " " SECOND FLOOR



PLAN OF FARM BUILDINGS.



STABLE, PIGGERY AND SHEEP SHED



MAP·OF·LAND·LEASED·TO·THE

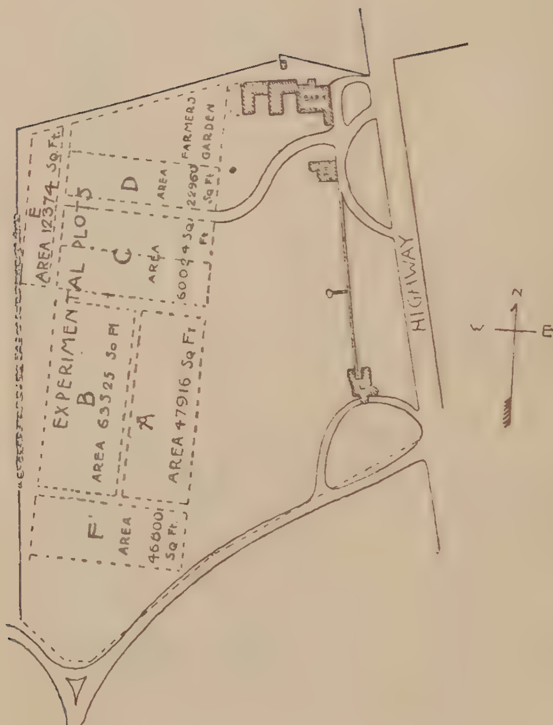
·MASSACHUSETTS·EXPERIMENT·STATION·

·FROM·THE·

·AGRICULTURAL·COLLEGE·FARM·

·EAST OF THE·HIGHWAY·

·AREA·TAKEN ·3052 ACRES



·MAP·OF·LAND·LEASED·TO THE·
·MASSACHUSETTS·EXPERIMENT·STATION·
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·AGRICULTURAL·COLLEGE·FARM
·WEST·OF THE HIGHWAY·
·AREA·TAKEN 1772 ACRES·

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